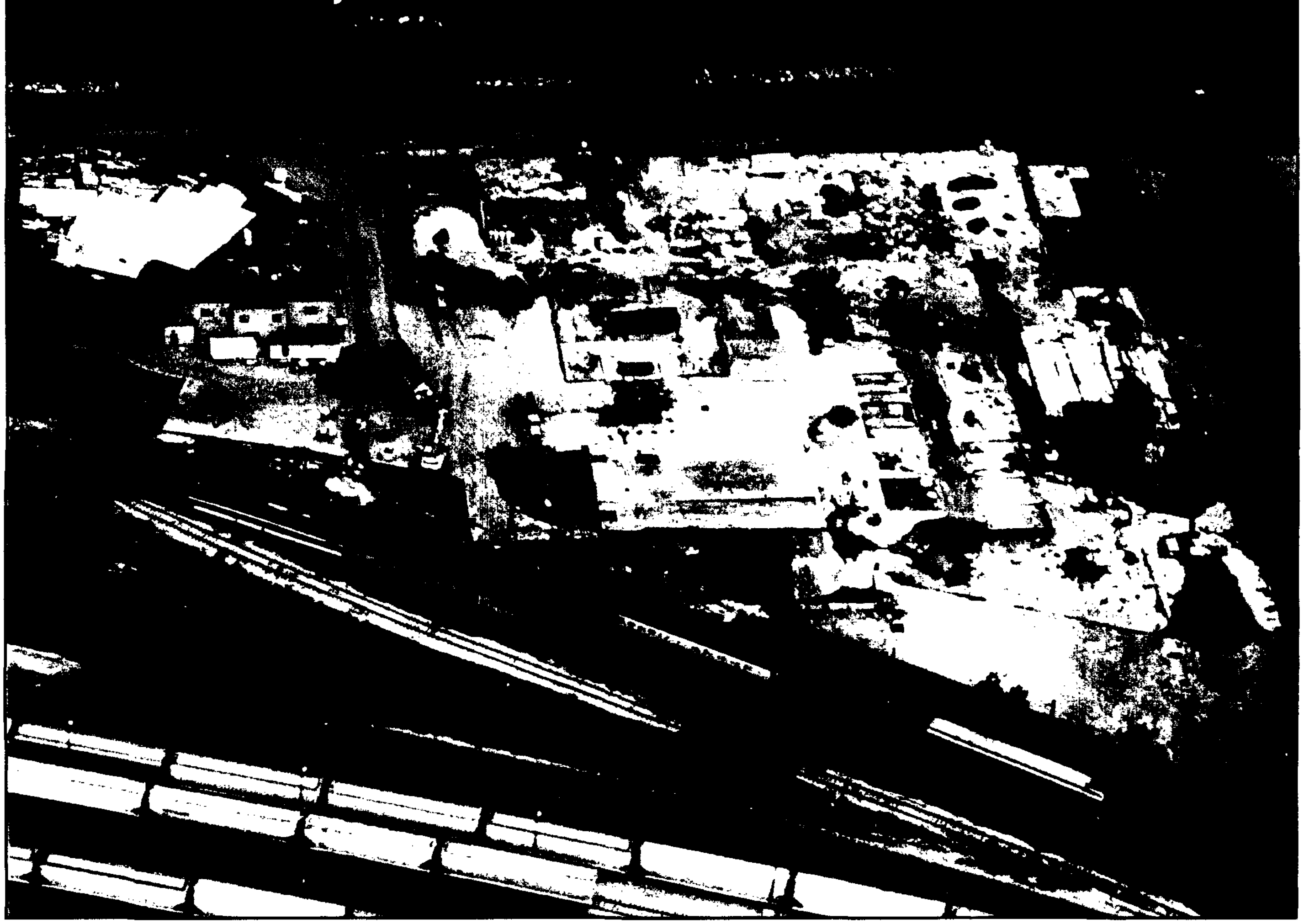
Engineering Evaluation and Cost Analysis (EE/CA)

eading the Nation in Customer Care

for the Master Metals, Inc. Site

Cleveland, Ohio



Prepared by:
ENTACT, Inc.

November 23, 1998

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

10 December 1998

REPLY TO THE ATTENTION OF SR-6J

Mr. Michael DeRosa
1360 North Wood Dale Road
Suite A
Wood Dale, IL 60191

Subject: Master Metals, Inc. Site, Approval of Engineering Evaluation and Cost Analysis (EE/CA)

Dear Mr. DeRosa:

The U.S. Environmental Protection Agency (U.S. EPA) and the Ohio Environmental Protection Agency (Ohio EPA) have completed their review of the revised EE/CA, dated 23 November 1998 for Master Metals Site in Cleveland, Ohio. Neither U.S. EPA nor the Ohio EPA has any further comments at this time. The document is considered complete and is approved by U.S EPA.

If you have any questions or comments please contact me at (312) 353-5263.

Sincerely,

Jeffrey B. Heath

Jeffrey B. Heath
Remedial Project Manager

cc: Don Bruce, U.S. EPA, RRS#4
Sheila Abraham, OEPA
Kris Vezner, U.S. EPA

ENTACT

November 20, 1998

Mr. Jeff Heath
U.S. EPA
77 West Jackson
Chicago, Illinois 60604

Dear Mr. Heath:

Please find enclosed a copy of the revised Engineering Evaluation/Cost Analysis (EE/CA) for the Master Metals Site (MMI) in Cleveland, Ohio. ENTACT has incorporated changes to this document based on U.S. EPA final comments dated May 26, 1998, October 1, 1998, subsequent conference calls and Ohio EPA comments dated May 29, 1998 and August 14, 1998.

If you have any questions, please contact me at (630) 616-2100.

Respectfully,

Michael DeRosa

Michael DeRosa
ENTACT

Enclosure

cc: Sheila Abraham, OEPA (w/enclosure)
Kris Vezner, U.S. EPA (w/enclosure)
Master Metals Technical Committee (w/enclosure)

Engineering Evaluation and Cost Analysis (EE/CA)

ENTACT

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Master Metals, Inc. Site

Prepared by:

ENTACT, Inc.
November 23, 1998

1360 North Wood Dale Road Suite A Wood Dale, Illinois 60191 Phone (630) 616-2100

Engineering Evaluation
and Cost Analysis (EE/CA)

Master Metals, Inc. Site
Cleveland, Ohio

Leading the Nation in Customer Care

Table of Contents

Executive Summary

This document presents the Engineering Evaluation and Cost Analysis (EE/CA) for the Master Metals, Inc. (MMI) site in Cleveland, Ohio. The EE/CA document is being prepared by ENTACT Inc. (ENTACT) in response to the Administrative Order by Consent pursuant to Section 106 of CERCLA (Administrative Order Docket number V-W-97-C-402); issued on April 17, 1997 by the Environmental Protection Agency Region 5 (EPA). This report satisfies the requirements of the Order and the EPA approved workplan for the Site.

The Master Metals, Inc. (MMI) Site is located on West Third Street in the City of Cleveland, Township 7 North, Range 12 West, Section 17, Fraction NE 1/4 SW 1/4 SW 1/4 in Cuyahoga County, Ohio. The MMI property (the "Site") itself encompasses approximately 4 acres. The Site is located in a heavily industrialized area of the "flats" of the Cuyahoga River. This site is located on top of slag fill material that was reportedly deposited throughout the area during industrial development in the early 1900s (ESC, 1991; PRC, 1994).

The area of concern for this EE/CA is the current MMI industrial property and the areas immediately outside of the existing perimeter chain-link fence. The off-site areas extend outward from the eastern, western, and southern boundary lines of MMI as follows: the eastern and southern off-site area extend outward from the property line and end at the existing concrete curb of West Third Street; the western off-site areas extend outward from the property lines and terminate at visual surficial evidence of manufacturing operation impact between the MMI facility and the eastern edge of the adjoining railroad spur.

Based on extensive historical and EE/CA derived sampling, lead is the predominant hazardous constituent of concern at the MMI Site. On-site solid media exhibit significant lead contamination (up to 35,000 mg/kg) to a depth of three to four feet. Perimeter solid media proximate to the facility fence exhibit surficial lead concentrations from approximately 1,000 mg/kg to 36,000 mg/kg. Groundwater is not used as a source of drinking water within a four mile radius of the MMI site. Lake Erie supplies the greater Cleveland area with its drinking water. In addition, there are no downgradient groundwater receptors.

A streamlined risk evaluation has been undertaken to develop an appropriate clean-up or Risk Based Remediation Goal (RBRG), for the residual concentration of lead remaining in the soils at the MMI Site. This assessment will be used to determine what level of residual lead will require additional action to protect human health at the site. The EPA document *Recommendations of the Technical Review Workgroup for Lead for an Interim Approach for Assessing Risks Associated with Adult Exposures to Lead in Soil, December, 1996,* is the model that has been employed in this analysis.

Based on the site conditions, demographics, and the site-specific exposure scenario, a RBRG for non-residential full-time worker exposure that results in a 95% probability that the blood lead concentration in a developing fetus will not exceed 10 μg/dL was determined to be 1,354 mg/kg (rounded to 1,350 mg/kg). The RBRG for non-residential construction worker exposure scenario that results in a 95% probability that the blood lead concentration in a developing fetus will not exceed 10 μg/dL was determined to between 901 and 1,159 mg/kg. This range is based on the plausible range of soil ingestion input values. Because the range is sufficiently protective, the average within this range (1,030 mg/kg) would provide a reasonable cleanup goal. Although a value of 1,030 mg/kg was derived, rounding down to 1,000 mg/kg provides an additional protection factor for exposure.

The RBRG is likely to be a conservative representation of the soil lead level because the site is covered over 90% of its area with concrete. In addition, during the time critical removal, at least two feet of lead impacted material was removed from all exposed soil areas of the site. Therefore, time critical removal activities have minimized lead exposure conditions in localized areas of the site. However, in those areas where lead impacted soil still are present, concentrations have been determined to exceed 1,000 mg/kg. Because a construction worker would have exposure to subsurface soils during site activities and since excavation of the entire property to this cleanup goal is fiscally infeasible (the entire region is underlain by slag containing lead concentrations), a combination of on-site institutional controls (deed restrictions, contaminant containment, etc.) combined with off-site excavation will provide an effective means of exposure mitigation rendering the exposure pathway incomplete thereby protecting human health.

On behalf of the Respondents, ENTACT developed and evaluated a number of alternatives for remediation of the Site. The alternatives were evaluated based on the criteria specified in the Order. Additional factors used in selecting the preferred remedy included the nature of site surroundings and the best end use for property. Given the location between the CSX property to the west of the Site and the railroad tracks and LTV Steel to the east of the Site, this Site clearly is not suitable for residential purposes. It is evident based on the location and history of the site and its surroundings that this area will always be zoned industrial and no other types of zoning would be possible. The only use for this property will be industrial/commercial.

Many alternatives were designed and a cost-benefit analysis was performed for each alternative. Each alternative was developed based on a streamlined approach to identify the more appropriate and feasible alternatives for meeting site remedial objectives. This evaluation provided the following alternatives:

Alternative 1 - No Action

Alternative 2 - Off-site Excavation, On-site Consolidation, On-site Cover, Operation & Maintenance (O & M)

Alternative 3 - Off-site Excavation, On-site Consolidation, On-site Capping, O & M

Alternative 4 - Off-site Excavation, Treatment, Off-site Disposal, On-site Capping, O & M

A systematic and qualitative comparison of each alternative was performed to identify the most effective and appropriate removal action.

The selected remedy for this remedial action is Alternative 2: Off-site Excavation, On-Site Consolidation, and On-site Cover. This alternative eliminates all off-site exposures to human health and the environment. In addition, this alternative significantly reduces the on-site direct contact, inhalation and ingestion pathways with the two feet of cover. Institutional controls in the form of deed restrictions, will ensure the remedy is effective in perpetuity

It is unclear how redevelopment may impact any future remediation. However, there may be remediation aspects of the preferred alternative which would provide flexibility to future redevelopment. For example, should the site be redeveloped, the cover system may undergo regrading with no disruption or intrusion into the contaminated subsurface.

1.0 INTRODUCTION

This document presents the Engineering Evaluation and Cost Analysis (EE/CA) for the Master Metals, Inc. (MMI) site in Cleveland, Ohio. The EE/CA document is being prepared by ENTACT Inc. (ENTACT) in response to the Administrative Order by Consent Pursuant to Section 106 of CERCLA (Administrative Order Docket number V-W-97-C-402); issued on April 17, 1997 by the Environmental Protection Agency Region 5 (EPA).

The Administrative Order Section V. 2. designates work to be performed. Sub-Section 2.2 of the Administrative Order requires the Phase II EE/CA Report in accordance with a scope of work (SOW) attached to the Administrative Order. That SOW lists five tasks to be completed as part of the EE/CA process. This EE/CA Report is submitted to satisfy Task 5 of the SOW.

2.0 SITE CHARACTERIZATION

2.1 Site Description and Background

2.1.1 Facility Location and Physical Setting

The Master Metals, Inc. (MMI) Site is located on West Third Street in the City of Cleveland, Township 7 North, Range 12 West, Section 17, Fraction NE 1/4 SW 1/4 SW 1/4 in Cuyahoga County, Ohio. Coordinates corresponding to the facility main entrance in the northeast corner are 41 degrees 28 minutes 26 seconds latitude and -81 degrees 40 minutes 31 seconds longitude which represent the best location for the facility as determined through the preferred coordinate calculation. The coordinates were obtained from the Facility Index System (FINDS) monitored by the U.S. EPA. The site location is shown in Figure 2.1.

The MMI property (the "Site") itself encompasses approximately 4 acres. The Site is triangular in shape with a right angle located in the southeast corner of the site and bearing approximate dimensions of 800 feet along the eastern side and 425 feet on the southern side. It is bordered on two sides by railroad tracks, with an LTV Steel facility located immediately to the east and south. Approximately 90% of the surface of the property is covered by concrete foundations and pads with vegetation consisting solely of small trees, brush and weeds only present outside of the perimeter fence.

Current structures on-site consist of a two-story office building, a roundhouse structure partitioned into two sections, and concrete foundation walls remaining from demolition activities conducted during the Phase I Time-Critical Removal Action at the MMI Site. The office building remains in good condition despite past scavenging and vandal activities. However, the roundhouse structure is in poor condition due to age and poor maintenance.

The Site is located in a heavily industrialized area of the "flats" of the Cuyahoga River. The Site has potential for future redevelopment. The Site has potential reuse as an industrial facility only. No commercial or residential opportunities are available for this facility due to this industrial setting. Currently, the office building is less than ten years in age. This building currently has access to water, electricity, gas and sewer.

There are currently no existing surface water bodies on-site. Surface water drainage is controlled partially by the on-site stormwater sumps and catchment basins. Uncontrolled stormwater collects in a low-lying area located along the central portion of the western border. There are no existing drainage channels conveying surface water runoff from the site.

The area of concern for this EE/CA is the current industrial property and the areas immediately outside of the existing perimeter chain-link fence. The off-site areas extend outward from the eastern, western, and southern boundary lines of MMI as follows: the eastern and southern off-site area extend outward from the property line and end at the existing concrete curb of West Third Street; the western off-site areas extend outward from the property lines and extends to the point where visual surficial evidence of manufacturing operation impacts (i.e. battery chips) from the MMI facility end.

2.1.2 Past Facility Operations

This site is located on top of historic slag fill material that was reportedly deposited throughout the area during industrial development in the early 1900s (ESC, 1991;PRC, 1994). Between 1933 and 1979, NL Industries, Inc. (NL), owned and operated a secondary lead smelter at the site. Feedstock for the secondary lead smelter consisted primarily of spent lead acid batteries and various other lead bearing materials. In 1935, NL installed a baghouse to capture particulate matter generated by the two rotary furnaces. In 1968, NL constructed three more baghouses to capture particulate matter generated by the refining kettles and other exhaust producing process equipment.

In 1979, NL sold the plant to Douglas Mickey, who continued operating the plant under the name Master Metals, Inc. During its operations, MMI processed lead acid batteries and a variety of other lead-bearing materials using a secondary smelting process. Rotary furnaces and refining kettles were used to convert the lead-bearing feed material into lead ingots. MMI received lead-bearing materials from various off-site sources.

Lead-bearing feed material, other than batteries, was transported to the MMI facility and stored on-site in one of two ways: (1) in bins, boxes, or drums or (2) stock-piled directly on the ground surface. MMI used a bulldozer to move feed material from storage areas to the furnaces. Batteries were stored at two locations on-site. Originally, batteries were stored in the former dismantling building, which was located in the site's southwest corner (now the container storage area). Batteries were cracked in the battery storage area near the main gate. Lead-bearing portions of the batteries were then transferred to the facility's furnaces for reclamation.

The MMI facility's rotary furnace could process up to seven tons of lead-bearing materials each hour. Lead-bearing feed material was classified and regulated by the EPA as D008 hazardous waste. In 1980, MMI estimated that it generated 42,960 tons of D008 waste per year.

In order to control particulate emissions, the smelter and exhaust producing process equipment was serviced by a baghouse to collect particulate materials. According to MMI's Part A application, particulate materials, called baghouse dust or emission control dust (ECD), and the sludge remaining in the furnaces were both classified and regulated by EPA as K069 hazardous waste. In 1980, MMI estimated that it generated approximately 1,920 tons of K069 waste per year.

The by-products of the smelting operation included furnace flux, slag, dross, ECD, and ECD sludge. The furnace flux, slag, dross, ECD, and associated sludge were recycled in the facility's furnace.

Finished lead ingots were stored in the roundhouse at the north end of the property prior to shipment. MMI primarily sold its lead ingots to battery manufacturers. In 1980, MMI produced an estimated 15,000 tons of lead ingots.

Four aboveground storage tanks were also present on-site: one tank was used to store diesel fuel, one was used to store motor oil, one was used to store gasoline, and one was used to store hydraulic fluid. Each of these tanks has a 500-gallon capacity. A fifth tank, which had a 10,000-gallon capacity, was not used by MMI.

2.1.3 Regulatory History

- RCRA Regulation

In November 1980, MMI submitted a RCRA Part A permit application. The Part A permit application states that the facility had a container storage area (S01) capable of storing 152 gallons of material, tank storage capable of storing 600 gallons of material, and six waste piles used to store 687 cubic yards of material. The facility application also stated that it operated an incinerator treatment system (T03) process capable of handling 20 gallons per hour, a blast furnace process (T03) capable of processing 7 tons of material per hour, and a refining kettle (T04) capable of handling 7 tons of material per hour. MMI stated that it handled 44,880 tons of lead-bearing material annually. Of this material 42,960 tons was designated D008 waste and 1,920 tons was designated K069 waste.

In September 1985, OEPA requested that MMI submit a RCRA Part B permit application for the facility's six waste piles. Subsequent to MMI's submittal of this application, OEPA sent MMI notices of deficiency in January and June 1986. After not responding to the notices of deficiency, MMI lost its interim status for the six waste piles in 1986. In July 1986, OEPA referred a case against MMI to the U.S. Department of Justice (DOJ) based on the facility's loss of interim status.

During an unannounced RCRA inspection in April 1988, OEPA noted uncovered waste piles, battery acid dripping onto the ground, and puddles of liquid with a pH of less than 2. In October 1988, the Cleveland Fire Prevention Bureau conducted an unrelated inspection at the MMI facility that revealed many violations, including a lack of permits for storing or using hazardous materials and improperly labeled waste. The Cleveland Fire Prevention Bureau also said that the structural integrity of all the MMI buildings needed to be documented and that the buildings should be razed, if necessary, based on their unstable appearance.

In January 1990, MMI entered into a consent agreement with EPA as a result of continued RCRA violations. The consent decree required MMI to properly track all hazardous wastes on-site, to submit annual reports to OEPA, and to cease cracking batteries on-site. These activities were suspended until MMI could prove it was in full compliance with RCRA as a treatment, storage, and disposal facility and could submit a contingency plan and a closure plan for all the RCRA-regulated solid waste management units (SWMUs) previously identified. The consent decree required that an investigation be conducted to determine subsurface and groundwater conditions at the facility. The consent decree also required MMI to characterize waste on-site, to store waste properly, and to remove or process all china clay waste.

In March 1990, Woodward-Clyde Consultants submitted a partial closure plan on behalf of MMI. The partial closure plan itemized the steps necessary to close the waste piles, battery cracking area, and former container storage area. In April 1990, Envisage Environmental Inc. submitted a RCRA Part B permit application for these SWMUs on behalf of MMI.

Between 1990 and 1992, MMI submitted the partial closure plan discussed above, a battery cracking plan, a contingency plan, a waste analysis plan, and a facility inspection plan. MMI received notices of deficiency for all of these plans. EPA also notified MMI that it had not adequately demonstrated its financial ability to assure clean closure of the facility.

- OSHA Regulation

In June 1986, OSHA determined that the average MMI employee was being exposed to lead at a time weighted average (TWA) level of 430 micrograms per cubic meter ($\mu g/m^3$) of air over an 8-hour time period. This level of lead exposure far exceeded the OSHA-published permissible exposure limit (PEL) of 0.05 mg/m^3 (50 $\mu g/m^3$) (DOL 1987 and 1988; National Institute of Occupational Safety and Health [NIOSH] 1990). Between August 3, 1987, and February 24, 1988, MMI was cited for four other OSHA violations and failure to abate these alleged violations. Some of these violations included repeated employee exposure to airborne lead concentrations greater than the OSHA PEL in both the front office and the employee lunch room, lack of respiratory protection, and improperly labeled hazardous waste containers.

Between January 11, 1990, and March 23, 1990, OSHA noted many additional violations at the MMI site. These violations again included employee exposure to lead. In at least 41 instances, employees were not informed when their blood lead concentrations exceeded the OSHA standard nor were they removed from their work areas. Furthermore, airborne lead concentrations continued to remain elevated in the employee lunch room.

In June 1990, a U.S. District Judge issued a restraining order demanding that MMI employees with high concentrations of lead in their blood be removed from the work place. However, at least seven of the 40 employees were still working on-site after this order was given. OSHA later discovered that some of the blood lead data it received was altered by MMI to reflect lower blood lead concentrations in MMI employees.

- Northeast Ohio Regional Sewer District (NEORSD)

MMI received a permit to operate its furnaces from the City of Cleveland's Division of Air Pollution Control. This permit allowed MMI a maximum production rate of 2,500 pounds of lead per hour. This permit also regulated baghouse maintenance.

Beginning in 1980, NEORSD began documenting lead concentrations and low pH values in the MMI sewer line and in the waste acid runoff pit. As a result of NEORSD findings, EPA instructed MMI to install an on-site wastewater pretreatment system. By 1988, MMI had replaced the concrete pad beneath the battery cracking area in preparation for the new wastewater pretreatment system.

NEORSD records from 1980 to 1982 indicated that MMI emitted lead to the air at concentrations of up to 215 milligrams per cubic meter (mg/m^3) and that the facility was discharging lead to the NEORSD system at an average concentration of 48.8 milligrams per liter (mg/L).

In January 1992, OEPA installed three ambient air monitoring stations near the MMI site to determine lead concentrations in the ambient air so that the results could be compared to the National Ambient Air Quality Standard (NAAQS) quarterly average for lead, which is 1.5 $\mu g/m^3$. Every sixth day, OEPA monitored the air at the MMI site for lead concentrations. During the first two quarters of 1992, air samples collected from the station immediately downwind of MMI revealed an average lead concentration of approximately 38 $\mu g/m^3$ and 28 $\mu g/m^3$, respectively. These quarterly averages exceeded the NAAQS by 2,393 % and 1,707 % respectively. In April and May 1992, four more NAAQS violations were documented by air monitoring stations and MMI. MMI continued operations and, in July 1992, installed a sprinkler system along the West Third Street fence line in an attempt to prevent airborne lead from migrating off site.

In August 1992, OEPA's air monitoring stations continued to detect high concentrations of lead (12.30 $\mu g/m^3$). OEPA ordered MMI to cease all lead smelting operations until it could prove compliance with existing regulations. MMI agreed to cease plant operations for 30 days. At the end of August 1992, OEPA permitted MMI to reactivate the refining kettles, but would not allow MMI to operate its rotary furnace. OEPA's air monitoring stations located downwind of MMI again detected high concentrations of lead (14.64 $\mu g/m^3$) in September 1992 when compared to upwind samples.

In October 1992, OEPA directed MMI to install two additional air monitoring stations, one west of the site and one south of the site. Additionally, MMI was directed to install a meteorological station, to upgrade its battery cracking operations, to conduct further soil sampling, to maintain zero visible emissions, and to initiate a dust suppression program. In response to this last direction, MMI installed a corrugated fence approximately 10 feet tall between the air monitors and the eastern property line in an attempt to reduce the concentrations of lead migrating via the air. At this time, OEPA permitted MMI to resume operation of one rotary furnace.

In January 1993, EPA installed four air monitoring stations around the MMI site to confirm OEPA's previous findings and to rule out the possibility of other potential sources of contamination. Samples were collected every third day throughout 1993 to monitor the total amount of suspended particulate and lead concentrations in the air. Despite the shutdown of the facility's furnaces in August 1993, the downwind monitor routinely detected elevated lead concentrations as much as 500 times greater than the upwind concentrations and 33 times the NAAQS quarterly average.

MMI failed to maintain zero visible emissions, as stipulated by OEPA in October 1992, on numerous occasions between December 4, 1992, and April 30, 1993. Because of continuing NAAQS air violations at the MMI site, the Cleveland Division of Air Pollution Control forced MMI to cease all operations in August 1993.

2.1.4 Surrounding Land Use and Populations

The MMI site is located in a heavily industrial area of Cuyahoga County, in Cleveland, Ohio. Virtually all land use within a one-quarter mile radius of the site is used for industrial purposes. The nearest residential area is approximately one-quarter mile northwest of the facility. The site is bounded by the railroads on the east and west. LTV Steel owns the property to the north and south of the MMI site (see Figure 2.1). Groundwater on-site is encountered between 3 and 10 feet bgs.

In order to compile area demographics, the EPA Geographic Information Query System was searched. The demographics for a one mile radius around the MMI site is as follows:

Population By Origin	Total	Summary Stats	National Comparison 50 States/D.C.
White	4652	71.1%	75.6%
Black	1013	15.5%	11.8%
AmInd/Esk/Ale	31	0.5%	0.7%
Asian/PacIsnd	32	0.5%	2.8%
Other	7	0.1%	0.1%
Hispanic	808	12.3%	9.0%

A map of the population density is shown as Figure 2.2. The population density outlined above predominates in the northwest quadrant between one quarter and one mile beyond the facility.

2.1.5 Geology/Hydrology

The glacial and post-glacial surficial materials in the vicinity of the MMI site consist of tills, lacustrine, and fluvial deposits. The glacial deposits are generally less than 40 feet thick in the site area. Subsurface materials in the site vicinity consist of unconsolidated Pleistocene deposits overlying shale bedrock. The bedrock consists of Paleozoic-age unconsolidated shales and sandstones that range in age from late Devonian to early Pennsylvanian (E&E 1993).

Surface soils in the area are comprised of fill materials (cinders, slag, sand), and to a lesser extent, native soils (sand, silt, clay) deposited as glacial till or river alluvium. The MMI site is predominantly underlain by an industrial slag fill, presumably originating from other manufacturing operations that was reportedly deposited throughout the area during industrial development in the early 1900s (ESC 1991; PRC 1994). At the MMI site, concrete covers approximately 90 percent of the surface with fill materials, consisting of sand, cinders, slag, and gravel, covering the remaining surface areas.

The Cuyahoga River, which is located 1,300 feet east of the MMI site, is the nearest surface water body to the site. Regionally, groundwater flows generally toward the Cuyahoga River. Groundwater sampling of the upper water bearing zone on-site has indicated that groundwater was flowing in a southerly direction. It is unlikely that runoff from the site can migrate to the Cuyahoga River via an overland route because many natural and manmade barriers exist between the site and the river and no streams or ditches lead from the site to the Cuyahoga River.

According to the U.S. Geological Survey (USGS), the flow rate of the Cuyahoga River is about 832 cubic feet per second (cfs). The Cuyahoga River flows in a northwest direction and discharges to Lake Erie about 4 miles downstream from the Mary Street Pump Station. Lake Erie's average depth is 62 feet, but is about 45 feet deep close to the Cleveland shoreline.

Four drinking water intakes are located in Lake Erie between 6 and 13 miles downstream of the MMI site. The water from each intake is blended with water from the other intakes prior to being distributed to the 1.5 million customers residing within the greater Cleveland area.

2.1.6 Sensitive Ecosystems

No wetlands are known to exist along the banks of the Cuyahoga river or the shore of Lake Erie within 15 miles of the site. Furthermore, based on USGS topographic maps, sensitive environments do not exist along the banks of the Cuyahoga River or the shore of Lake Erie within 15 miles of the Site.

2.1.7 Meteorology

Local weather stability is attributable to the presence of Lake Erie. Temperatures remain relatively mild throughout the year. Average monthly temperatures range between 47 and 72 degrees Fahrenheit during the spring and summer months and between 24 and 53 degrees Fahrenheit during the winter months. Average monthly precipitation ranges between 2.04 and 3.70 inches. Prevailing wind on-site is out of the south/southwest.

2.2 Previous Removal Action

This section summarizes the scope and objectives of previous removal action conducted at the area of concern. The Phase I Time-Critical Removal Action for the MMI Site was initiated in June 1997 and completed in January 1998.

2.2.1 Scope and Objectives of Previous Removal Action

Objectives for the Phase I Time-Critical Removal Action initially detailed in the Administrative Order by Consent for the MMI Site are outlined below:

- Analysis and mapping of all waste materials and contamination at the facility for removal purposes;
- Long-term securing of the facility against trespassers through the use of fences, signs and other devices, as necessary;
- Excavation, demolition, consolidation, and/or removal of highly contaminated buildings, structures, soils, loose waste materials, loose industrial debris and office or industrial equipment, where such actions will reduce the spread of, or direct contact with, the contamination;
- Removal of drums, barrels, tanks, or other bulk containers that contain or may contain hazardous substances or pollutants or contaminants where such actions will reduce the likelihood of spillage or of exposure to humans, animals or the food chain;
- Containment, treatment, disposal, or incineration of hazardous materials, where such action is necessary to reduce the likelihood of human, animal or food chain exposure.

This work was performed during the time period between June 9, 1997 and January 6, 1998. The following sections summarize the removal actions and Section 2.4 discusses the data associated with these actions.

2.2.2 Nature and Extent of Hazardous Substances Removed

Waste materials and contamination on-site were present in various forms prior to the initiation of removal activities. Solid media was stored in 55-gallon and 30-gallon drums, 1 yd^3 Gaylord boxes, metal roll-off boxes, plastic buckets, wooden storage bins, pallet sacks, and loose waste piles around the site. Various liquid wastes were also present on-site. The above ground storage tank farm contained various fuels and oils and the roundhouse structure contained approximately fifty 55-gallon drums with oils, acids, degreasers, and other fluids. Approximately two hundred laboratory chemicals were also on-site. Large quantities of industrial and structural debris also required removal in accordance with the Order.

► Solid Media

Solid waste material and contamination on-site were analyzed for toxicity characteristics prior to any removal or stabilization activities being performed. Materials exhibiting the toxicity characteristic of lead, cadmium or arsenic were secured until treatability analysis was complete.

Thirteen hazardous waste steams were identified through the characterization analysis. Eleven of the thirteen waste streams were amenable to treatment utilizing ENTACT's patented treatment technology. Treated solid media, after analytical verification, was disposed of as special waste by Browning-Ferris Industries at the Ottawa County Subtitle D Landfill in Port Clinton, Ohio. The Treatability Study Report for the Master Metals Site, including treatment technology and verification strategy, is described in Section 8 of the Phase I Time-Critical Removal report.

Waste streams not amenable to treatment and K069 waste extracted from the dust collection units on-site were manifested as hazardous waste to Dynecol, Inc. in Detroit, Michigan for final disposal from this Port of Entry to Laidlaw's facility in Corunna, Ontario, Canada. Materials of known composition (orphaned laboratory chemicals and chromium trioxide) were disposed of at hazardous waste incinerators operated by Laidlaw Environmental Services in Bridgeport, New Jersey (laboratory chemicals) and by Waste Technologies Industries in East Liverpool, Ohio (chromium trioxide).

The removal action resulted in the following disposal amounts: Treated Solid Non-hazardous waste - 4,800 yd^3; brick/concrete special waste - 500 yd^3; asbestos containing material - 21 tons; K069, D006, D008 waste - 1,160 yd^3; chromium trioxide - 3,600 yd^3; and laboratory chemicals - over 200 bottles.

► Liquid Media

Liquid waste materials were ubiquitous around the Site. Liquids were stored in various containers (i.e. 55 gal drums, 500 gal tanks, 5 gal buckets, open top metal boxes). Each liquid waste stream was profiled prior to disposal or recycling off-site. The following types of waste liquids were present on-site:

- motor oils, transmission fluids, and brake fluids
- fuels: gasoline, diesel, kerosene
- soaps and degreasers
- concentrated acidic and basic liquids

The combined waste liquid disposal exceeded 3,000 gallons. Waste liquid was manifested for disposal at Chemical Solvents Inc. in Cleveland, Ohio.

► Debris

On-site debris consisted of wood, concrete, plastic, metal, tires, machinery, construction materials and various other trash. Construction and demolition debris, as well as general trash and debris on-site, were decontaminated and sampled for hazardous characteristics prior to disposal off-site. These materials were analyzed and determined not to exhibit any hazardous waste characteristics. Metal (structural and sheet form) was decontaminated and loaded into roll-off boxes for recycling. All other debris was transported to a Construction and Demolition Debris landfill operated by Browning-Ferris Industries.

The following approximate amounts of debris were removed during the activities: scrap metal - 500 tons and other non-hazardous debris - 600 yd^3.

2.3 Source, Nature, And Extent of Contamination

2.3.1 On-Site Sampling

Compliance Technologies, Inc. (CTI) conducted a Phase II environmental assessment of the MMI Site in 1990. Thirty-four subsurface samples were collected and analyzed for the eight RCRA metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver). Samples were collected from two to five feet in depth and eight to ten feet in depth. Results revealed lead concentrations which were 1-2 orders of magnitude higher than the other metals. Lead concentrations are shown in Figure 2.3. Slightly elevated concentrations of chromium and cadmium were observed in17 of the 34 samples. The analytical results for all metal concentrations determined during this sampling can be found in the document entitled "Subsurface Investigation Report for Master Metals" (January 21, 1991).

In July, 1992, Ecology and Environment (on behalf of the U.S. EPA) collected seven surface samples on-site (SS1 through SS7). The lead results associated with this data collection effort are shown in Figure 2.3. This investigation analyzed samples for the eight RCRA metals (arsenic, cadmium, chromium, lead, mercury, barium, silver, and selenium). Once again, lead values were 1-2 orders of magnitude higher than all other metals. Some results exhibited minor arsenic, barium, cadmium, and chromium concentrations, relative to lead concentrations. The analytical results for all metal concentrations determined during this sampling event can be found in the document entitled "Site Assessment Report for the Master Metals Site" (August 13, 1992).

As part of the Phase I Time-Critical Removal conducted from June 1997 through January 1998, all exposed on-site surface areas (e.g., not covered by concrete) were excavated to a maximum depth of two feet or until historic slag fill materials (e.g., slag, cinders, etc.) were encountered. XRF information collected from the excavations exhibited lead concentrations up to 39,000 parts per million (ppm) in the remaining historic slag fill material. The post excavation XRF screening values and laboratory verification data can be found on Tables 7-1 and 7-2, respectively, of the document entitled "Final Report for the Phase I Time-Critical Removal Action at the Master Metals Site, Cleveland, Ohio".

This site is located on top of historic slag fill material that was reportedly deposited throughout the area during industrial development in the early 1900s (ESC, 1991; PRC,1994). The western low-lying areas confirm this finding. At a 2'-3' depth, there is appreciable amounts of historic slag fill and large metal "boulders". This material was found in 36 of the 38 excavated grids established on the western side of the site. Upon excavation of all grids, seventy-five percent (36 out of 48) of the grids exposed "native" slag material. This material has not been analyzed as it is considered historic fill.

Additional on-site investigation was conducted as part of the EE/CA. Seven borings were installed on-site in the vicinity of the Battery Storage Area, Drum and Container Storage Area, and the Former Rotary Furnaces. Figure 2.4 shows the locations of on-site borings ONS-01 through ONS-07. The borings were installed to approximately four feet below ground surface. The segments were screened for total lead with the XRF. Table 2.2 lists the XRF screening results and material descriptions for each boring interval. Only two borings (ONS-02 and ONS-03) exhibit significant XRF lead reductions with depth. Five of the seven on-site borings exceeded 1,500 ppm lead at total depth. The soil descriptions state that much of the material encountered at three to four feet depth is slag. This is consistent with the information collected from the soil excavation done as part of the Phase I Time-Critical Removal.

Table 2.3 shows the EE/CA laboratory verification data for total arsenic, total cadmium, total chromium, and total lead. The verification data shows that the primary metal of concern is lead. In addition, the laboratory data confirms the XRF screening information regarding significant lead contamination at depth.

Table 2.4 compares the XRF derived lead values with the laboratory derived values. It should be noted that the laboratory derived lead concentrations do not accurately reflect the XRF derived lead values. This is due to the heterogeneity of the on-site fill matrix. After the on-site surficial soils were removed, the underlying materials were noted to be predominately slag. The heterogeneity of slag will produce this XRF variability.

2.3.2 Off-Site Samples

In July 1992, Ecology and Environment (on behalf of U.S. EPA) collected samples proximate to the facility property to determine if the facility contaminants were subject to airborne transport. Analysis of these samples (SS8 through SS10) for RCRA metals showed total lead levels of 24,000 - 43,100 ppm (see Figure 2.3). The analytical results for all metal concentrations determined during this sampling can be found in the document entitled "Site Assessment Report for the Master Metals Site" (August 13, 1992).

From January 9-December 29, 1993, an air monitoring study was conducted by U.S. EPA (Cleveland office) to determine whether the MMI or other lead sources such as LTV Steel were the cause of high airborne lead readings at the MMI boundary. Four air samplers were placed between MMI and LTV Steel. Four monitoring stations were placed northeast, southwest, south-southwest, and south-southeast. The wind rose generated during the project shows the predominant wind directions to be northeast to easterly and south-southwesterly of the facility. Four hundred thirty-four samples were collected during this time period. This study determined that MMI was the source of the airborne lead and a very steep airborne lead concentration gradient existed around the facility over a distance of 0.25 miles. The data in this report clearly show that 90% of the air emissions attenuate within 0.25 miles of the site. Although no monitoring devices were placed northwest of the facility (near the residential areas) wind rose data confirms that this is not a significant wind direction.

In July 1993, off-site surface samples were collected from locations 0.4 miles northwest and west of the Site. These samples were collected near residential areas and indicated lead concentrations from 148 to 1,850 ppm. These are not atypical concentrations in urban areas which are heavily traveled by automobile traffic. Appendix B provides a discussion of lead impacts from other potential contributing sources such as lead-based paint and automobile emissions.

Additional off-site sampling was conducted as part of the EE/CA. Nine surface soil sample locations were collected along Quigley Avenue to determine if lead emissions from MMI affected the residential areas northwest of Quigley Avenue (see Figure 2.5). These sample locations (OS-01-03 through OS-09-03) were visually selected. Samples locations were chosen to obtain representative surficial soil potentially impacted by airborne deposition. This selection rationale allowed data assessment of potential airborne lead impacts from the Master Metals facility.

The laboratory derived soil lead concentrations are tabulated on Figure 2.5. The concentrations ranged from 85 mg/kg to 1,200 mg/kg. The average lead concentration of the nine investigative samples and the one duplicate sample was 375 mg/kg. This average lead concentration is lower than the Superfund residential soil screening level of 400 mg/kg. It should be noted that the highest lead concentration was located at OS-08-03. This sample was collected within 500 feet of the I-490 bypass. Therefore, this value may be indicative of historical lead contamination from transportation sources unrelated to the site. Based on the lead values found in the northwest/west direction of the site, it is evident that airborne lead impacts attributable to Master Metals in the vicinity of Quigley Avenue are minimal.

2.3.3 Perimeter Sample Results

Figure 2.4 shows the approximate location of the perimeter XRF lead survey samples (designated X-1 through X-19). Table 2.1 contains the XRF survey results. The XRF lead concentrations varied from 931 ppm lead at sample location X-8 to 36,587 ppm lead at sample location X-10. Based on these results, soil borings were installed at sample locations X-4 (3,360 ppm lead), X-7 (10,307 ppm), X-10 (36,587 ppm), and X-15 (21,237 ppm) with boring identifications PS-01 through PS-04, respectively. These boring locations are depicted in Figure 2.4.

Table 2.2 presents the boring screening results. Although the surficial XRF lead readings were as high as 36,587 ppm, the lead concentration decreased quickly with depth. At boring locations PS-01, PS-02, and PS-03 the lead XRF screening value of 1,000 ppm was reached at the 12"-24" segment. Boring location PS-04 reached the 1,000 ppm value at the 24"-36" segment. These sample intervals were sent to the laboratory for arsenic, lead, cadmium, and chromium analysis. The laboratory results are shown on Table 2.3. The laboratory results confirm that levels of lead contamination has been determined with respect to perimeter soils.

This site is located on top of historic slag fill material that was reportedly deposited throughout the area during industrial development in the early 1900s (ESC, 1991; PRC, 1994). Boring results confirm similar information collected during grid excavation. Three of the four borings

(75%) exhibited a significant "native" slag horizon at 2'-3' depth. At depth, slag percentages varied from 30%-100%.

Table 2.4 compares the XRF derived lead values with the laboratory derived values. It should be noted that the laboratory derived lead concentrations do not accurately reflect the XRF derived lead values for the on-site samples. The perimeter laboratory results show very good agreement with the XRF derived results at the low end of the concentration range. However, there may be some discrepancies in the higher concentration lead correlation values.

2.3.4 Groundwater

In December 1990, Master Metals contracted with Compliance Technologies to install and sample four on-site groundwater monitoring wells. Monitoring well locations can be found on Figure 2.3. Results of the sampling are as follows:

- The groundwater flows in a southerly direction beneath the Site.

- Total metal concentrations in the on-site groundwater ranged from 0.45 mg/L to 1.35 mg/L lead and 0.02 mg/L to 1.33 mg/L chromium with minor concentrations detected for cadmium, nickel and barium.

- The pH of the groundwater was between 6.80 and 9.86.

Groundwater is not used as a source of drinking water within a four mile radius of the MMI site. Lake Erie supplies the greater Cleveland area with its drinking water.

Another groundwater sampling event was conducted as part of the EE/CA. Figure 2.6 shows the location of the three remaining on-site monitoring wells at Master Metals, the total and dissolved groundwater metal concentrations found during this sampling event, and the groundwater monitoring results for the 1990 CTI sampling. Monitoring wells MW-02 and MW-03 exhibit concentrations of total arsenic, total cadmium, total chromium, and total lead ranging from 0.011 mg/L to 10.8 mg/L. Monitoring well MW-02 exhibits total metal concentrations which are an order of magnitude greater than monitoring well MW-03. However, monitoring well MW-02 was bailed dry and when the well recovered, the groundwater sample was significantly more turbid than the sample from MW-03 resulting in the anomalous concentrations. As can be seen from the dissolved metal concentrations, field filtering of samples MW-02 and MW-03 exhibit the same relative metal concentrations (arsenic and lead).

As stated in the EE/CA workplan, the groundwater in this area is not currently and will not be a source of drinking water. More importantly, the concentrations of total arsenic, total cadmium, total chromium, and total lead in the aquifer have not increased in six years and has actually decreased in MW-01. Therefore, groundwater does not warrant long-term monitoring.

2.3.5 On-Site Sump Assessment

As part of the Phase I Time-Critical Removal Action, ENTACT identified thirteen (13) square sumps: two in the southern section of the roundhouse, two in the battery breaking area, and nine around the former white metals building and former brick baghouses. ENTACT removed all sludge/sediment contained in each of the sumps and all associated competent piping. This material was then treated and disposed properly. Following removal, ENTACT subcontracted a sewer cleaning company to perform site reconnaissance to determine the status of the existing sump network through video surveying.

The sump system was constructed by placing precast concrete subgrade and connecting four inch plastic pipe between sumps to gravity feed water to a central location. The two sumps in the roundhouse are stand alone water collection units. The sump and subgrade tank in the battery breaking area worked in concert to collect acid from battery processing activities. Neither the battery breaking area sumps nor the roundhouse sumps are connected to any other portions of the sump system. All sumps were found to be sound based on visual inspection.

There are ten round drain covers on the site. Three of the covers are cleanouts or floor drains that were located in the former white metals building, the shipping and receiving building, and the furnace building. These cleanouts and floor drains are not interconnected to any other sump or drain. Another drain, located in the truck ramp area, was not investigated because it was not part of the on-site waste stream system and is spatially distinct from other waste stream pathways. The remaining six on-site covers were manhole covers yielding access to a subsurface network of conduits. According to the sewer investigation subcontractors, the cover located outside the roundhouse was abandoned and inoperable. The sewer cover located in the south central portion of site is the access for a 36 inch diameter line flowing east to west. Two eight inch clay tiles connect to the main line of this manhole. One flows into the 36 inch line from the north and the other flows into the 36 inch line from the southwestern direction.

Three of the four sewer covers and the garage drain located near the office building were also inspected. These sewers were cleaned out to facilitate investigation. It should be noted that there was no evidence to support flowing water in any of these three sewers. In addition, it was evident that attempts had been made to internally concrete these sewers. After sediment and sludge removal, it was determined that each of these manholes contained only one line entering/exiting the catch basin. None of these lines are connected to any other sumps or sewers on the property.

2.3.6 Site Impact and Potential for Releases

Based on extensive historical and EE/CA derived sampling, lead is the predominant hazardous constituent of concern at the MMI Site. On-site and perimeter lead concentrations are higher and more prevalent than any other heavy metal analyzed. Although there were isolated instances of elevated arsenic concentrations in some samples, this analysis has been designed to address a remedy for lead. The remedy selected for site stabilization of lead will also remedy the co-located elevated levels of arsenic. For example, capping options will mitigate all heavy metal exposure. Stabilization/solidification has also been shown to be effective treatment for both lead and arsenic. Section 8 of the Phase I Time-Critical Removal report describes the effectiveness of treating heavy metal contaminated materials found at the MMI Site.

On-site solid media exhibit significant lead contamination (up to 35,000 mg/kg) to a depth of three to four feet. This level of contamination cannot be isolated to a few localized areas on-site. Both the XRF survey of the excavated southern and western on-site grids and the lateral extent of contamination borings exhibit lead concentrations at depth in the vicinity of 10,000 mg/kg. Forty-eight excavated grids exhibited an average of 7,550 mg/kg lead (XRF-derived) while six borings exhibited an average of approximately 12,500 mg/kg lead (laboratory-derived). As part of the Phase I Time-Critical Removal, these excavated areas were backfilled with clean sand to mitigate any further entrainment of airborne lead. Therefore, the air pathway exposure from these on-site excavations is not a concern. However, much of the concrete is compromised over the site and there is a potential for airborne lead releases.

Perimeter soils proximate to the facility fence exhibit surficial lead concentrations from approximately 1,000 mg/kg to 36,000 mg/kg. The lead concentrations decrease rapidly with depth. Lead concentrations are below 1,000 mg/kg at a depth of twelve to twenty-four inches. Given the levels of surface soil contamination, there is presently a potential for inhalation and ingestion of surficial lead exists around the perimeter of the site.

Off-site soil samples collected along Quigley Avenue had an average lead concentration of 375 mg/kg. This average lead concentration is lower than the Superfund residential soil screening level of 400 mg/kg. Therefore, there is no potential for impact in nearby residential areas from the MMI Site.

On-site groundwater sampling results indicate the concentrations of total arsenic, total cadmium, total chromium, and total lead have not significantly increased in six years. Currently, groundwater in this area is not a source of drinking water. A water well search within one mile of the facility was requested through the Ohio Department of Natural Resources Division of Water. Figure 2.7 shows the location of the five wells. All five wells are associated with manufacturing operations and are located three-quarters of a mile upgradient of the facility. Therefore, the groundwater migration pathway is eliminated as a concern based on stable concentrations of target metals and lack of any downgradient receptors.

Future groundwater exposure can be assured through the implementation of on-site controls such as deed restrictions to mitigate these potential exposures. Deed restrictions will need to be placed on the property which restricts the usage of groundwater at this site. In addition, placing lead contaminated material under a cover system will aid in minimizing vertical infiltration of water through the lead contaminated material to the groundwater. Lead is not very mobile and tends to attenuate rapidly over short distances.

2.4 Analytical Data

Data collected during the Phase I Time-Critical Removal Action is considered screening data, Data Quality Level II which was laboratory-confirmed at a rate of ten percent of grid locations. The data generated during the EE/CA sampling was a combination of screening data for rapid, real-time data assessment and laboratory-generated Data Quality Level III data used for confirmational data assessment purposes. All off-site soil samples were laboratory derived data. Perimeter soil samples were screening data to locate the highest lead values on each side of the facility combined with laboratory analysis of an expanded list of metals to assess and confirm extent of contamination. All laboratory derived data generated during the EE/CA can be found in Appendix A of the report "Engineering Evaluation and Cost Analysis (EE/CA) Data Report" (January 19, 1998).

2.5 Streamlined Risk Evaluation

This streamlined risk evaluation has been undertaken to develop an appropriate clean-up or Risk Based Remediation Goal (RBRG), for the residual concentration of lead remaining in the soils at the MMI Site. This assessment will be used to determine what level of residual lead will require additional action to protect human health at the site. Residual lead contamination in soils greater than or equal to the RBRG for soil lead levels may require remedial action to protect human health.

The streamlined risk evaluation for the MMI site focuses on the potential current exposures of individuals to lead at this site. This evaluation:

- Characterizes the potential for lead exposure on the site and adjacent to the site perimeter;
- Assesses lead toxicity;
- Estimates an acceptable soil lead cleanup value;
- Discusses uncertainties within the evaluation.

2.5.1 Exposure Pathway Evaluation

Lead exposure scenarios can occur via inhalation of lead in air, dermal contact of lead in soil, and ingestion of lead in water and the diet. A site conceptual exposure model is provided as Figure 2.8. The soil ingestion and inhalation exposure pathways at this Site are expected to be complete since significant amounts of lead contaminated surficial soil are still present across the Site as well as around the near perimeter of the Site. However, the groundwater ingestion exposure pathway is not considered a concern since the city draws exclusively on Lake Erie for drinking water and there are no downgradient receptors.

A typical exposure pathway analysis focuses on the risk to individuals most likely to come into contact with the contaminated soil. As discussed previously, this is a heavily industrialized area with little to no foot traffic. Therefore, exposure to sensitive populations (e.g. children) or passersby is extremely low. The typical exposure pathways for this site involve the receptors shown in Figure 2.8. These receptors include the full-time facility worker and the full-time construction worker.

Inhalation of lead in air and ingestion of lead through incidental exposure are the most prevalent pathway exposures. Exposures to lead in air could be site related, since sources of lead still exist both in on-site deteriorated sections of concrete and perimeter surficial soils. Therefore, windblown transmission of these materials potentially complete this pathway. Due to the surficial soil located around the perimeter of the site, incidental soil ingestion through routine working activities makes this a potentially complete pathway.

As discussed previously, groundwater is not used as a source of drinking water and a pathway does not exist for contaminated soil discharge to surface waters. Therefore, ingestion of water is not a relevant pathway. Dermal absorption is not considered to be a significant exposure pathway since lead is very poorly absorbed through the skin.

2.5.2 Toxicity of Chemicals of Concern

Toxic effects of lead in children, the most sensitive human subpopulation, have been well characterized. These effects involve several target organ systems with the most sensitive effects in infants and children occurring in the central nervous system. Exposure to lead is usually characterized by elevated blood lead concentration. At blood levels greater than 80 μg/dL, children may experience coma, convulsions and even death. Lower blood lead levels can cause adverse effects on the central nervous system, kidney, and hematopoietic system. Common symptoms in children include anemia, hearing deficits, learning and language deficits, and attention span disorders which may lead to disruptive behavior. Blood levels as low as 10 μg/dL, which do not cause clinical symptoms, may be associated with decreased performance on test of cognitive function and impaired neurobehavioral development. Other subtle effects of low lead exposure to lead include decreased stature or growth, decreased hearing acuity, decreased ability to maintain a steady posture, and impairment of the synthesis of the active metabolite 1,25-$(OH)_2$ Vitamin D.

Studies have also indicated that deficits in mental development can occur to children born to mothers with elevated blood lead levels. While pregnant women may not be at great risk from slightly elevated blood lead levels, they are considered a sensitive population because lead in maternal blood is transferred across the placenta to the developing fetus. Maternal and cord blood lead levels of 10 to 15 μg/dL appear to be associated with reduced gestational age and reduced weight at birth, as well as with subtle neurodevelopmental deficits.

2.5.3 Risk Evaluation

The determination of the RBRG for the Site is the focus of this assessment. The EPA document *Recommendations of the Technical Review Workgroup for Lead for an Interim Approach for Assessing Risks Associated with Adult Exposures to Lead in Soil. December, 1996,* is the model that has been employed in this analysis.

The document *Recommendations of the Technical Review Workgroup for Lead for an Interim Approach for Assessing Risks Associated with Adult Exposures to Lead in Soil,* for performing this risk assessment was derived from extensive evaluations of the California Gulch NPL Site Risk Assessment by the Technical Review Workgroup (TRW) for Lead. Through research and evaluation, the TRW has developed a methodology for assessing risks associated with non-residential adult exposures to lead in soil. The risk methodology relates soil lead intake to blood lead concentrations in the most sensitive population which would be exposed to the site contaminants (women of child-bearing age) and is similar to a slope factor approach for deriving risk-based remediation goals (RBRG). The methodology uses a simplified representation of lead biokinetics to predict quasi-steady state blood lead concentrations among adults who have relatively steady patterns of site exposures.

The basis of the methodology is to estimate the soil lead concentration at which the probability of blood lead concentrations exceeding a given value (e.g.10 μg/dL) in the fetus of a women exposed to environmental lead in a non-residential setting is no greater than a specified value (e.g. 0.05). The risk assessment uses an initial estimate of blood lead level in an adult and then adds additional blood lead based on the Site Specific Exposure Scenario and approximate lead absorption fraction, adult intake rate of soil, and biokinetic slope factor relating blood lead level to average daily lead uptake. The applicable equations for this streamlined risk assessment can be found in Appendix A. A discussion of input parameter selection is outlined below.

Fetal Blood Lead Concentration (PbB_{fetal})

The default value of 10 μg/dL will be used based on previous discussions of potential toxicity effects at this level.

Individual Blood Lead Standard Devi^:ion (GSD_i)

The GSD_i is a measure of the inter-individual variability in blood lead concentrations in a population whose members are exposed to the same non-residential environmental lead levels. The plausible range for GSD_i is 1.8 - 2.1 based on the homogeneity or heterogeneity, respectively, with respect to racial, ethnic, cultural and socioeconomic factors that might effect exposure. Based on site specifics, a GSD_i value of 1.8 will be used assuming that the work exposures and habits of the Cleveland population are homogeneous.

Fetal/Maternal Blood Lead Concentration Ratio ($R_{fetal/maternal}$)

A default value of 0.9 was selected for this input parameter based on studies by Goyer (1990) and Graziano, et al.,1990) that have explored the relationship between umbilical cord and maternal blood lead concentrations.

Baseline Blood Lead Concentration ($PbB_{adult,0}$)

The baseline blood lead concentration is intended to represent the best estimate of a reasonable central value of blood lead concentration in women of child bearing age who are not exposed to non-residential soil at the site. Geometric blood lead concentrations are used for this purpose. Based on the results of the Phase I of the NHANES III survey reported by Brody et. al. (1994), the plausible range of blood lead concentrations varies from 1.7 - 2.2 μg/dL for women of child-bearing age (ages 17-49). A site-specific value of 2.0 μg/dL was chosen for this input parameter based on a mixed racial worker population.

Biokinetic Slope Factor (BKSF)

The BKSF relates the blood lead concentration to lead uptake. A default value of 0.4 μg Pb/dL blood per μg Pb absorbed per day was chosen for the BKSF parameter based on data reported by Pocock et. al. (1983).

Soil Lead Absorption Factor (AF_s)

This parameter represents the fraction of lead in soil ingested daily that is absorbed from the gastrointestinal tract. A default value of 0.12 will be used based on the assumption that the absorption factor for soluble lead ($AF_{soluble}$) is 0.2 and the relative bioavailability of lead in soil compared to soluble lead ($AF_{soil/soluble}$) is 0.6 such that:

$$AF_s = AF_{soluble} \cdot AF_{soil/soluble}$$

Exposure Frequency (EF_s) and Averaging Time (AT)

This represents the amount of time spent by workers on-site. For full time workers, this input parameter corresponds to an exposure frequency of 250 days per year (5 days per week for 50 work weeks) and an averaging time of 365 days (one calendar year).

For a construction worker, an appropriate exposure frequency of 172 days per year (4 days per week for 43 weeks) representing 80% of actual working time due to weather and other work related activities and an averaging time of 301 days is representative of site-specific construction worker conditions (i.e. construction season in Cleveland).

Daily Soil Ingestion Rate (IR_s)

This value quantifies the amount of soil ingested on a daily basis. A default value of 0.05 g/day is recommended as a plausible value for the full-time worker input parameter. This value represents the central tendency for daily soil intake from all occupational sources, including soil from indoor dust resulting from non-contact intensive activities. Calabrese et. al. (1987) suggested that soil intake among adults ranges from 0.001 to 0.100 g/day. In addition, Hawley (1985) estimated the annual average soil intake rate for adults to be 0.0605 g/day. This study included dust and soil as well as soil intake as a result of outdoor activities. Calabrese et. al. (1990) conducted a tracer study on six adults and determined a range of 0.030 to 0.100 g/day. In addition, the EPA Exposure Factors Handbook (1997) has recommended the value of 0.05 g/day as a reasonable central estimate of adult soil ingestion. Therefore, 0.05 g/day is an acceptable value and will be used for the on-site full-time worker scenario.

However, for a construction worker the daily ingestion rate of soil can be significantly higher. The IR_s value can range from 0.05 to 0.1 g/day for intensive contact activities as stated above. However, the EPA Exposure Factors Handbook (1997) states that uncertainties in the central estimate of 0.05 g/day preclude a recommendation of an upper percentile value for soil ingestion. A graph of the possible soil lead concentrations with increasing soil ingestion values (assuming all variables noted above are constant) is shown in Appendix A.

Soil intensive construction activities such as foundation creation where very large volumes of material will be exposed for large amounts of contact time will not be occurring at this site. The construction worker at and around this site would more than likely be performing trenching operations to install underground conduit for any number of utility purposes. However, because exposure over the averaging time is constant, the remediation goal would also be protective for on-site construction workers. This activity warrants a moderate soil ingestion rate as it is unlikely that a construction worker would ingest 0.1 g/day of soil during the entire project. Therefore, a moderate construction worker ingestion rate of 0.07 to 0.09 g/day will be a sufficiently protective input parameter.

2.5.4 Cleanup Goal Calculation

The development of the risk based remediation goal for lead in soil is based upon the target groups, as well as default and site specific parameters outlined above.

Based on the site conditions, demographics, and the site-specific exposure scenario, a RBRG for non-residential full-time worker exposure that results in a 95% probability that the blood lead concentration in a developing fetus will not exceed 10 μg/dL was determined to be 1,354 mg/kg (rounded to 1,350 mg/kg). The RBRG for non-residential construction worker exposure scenario that results in a 95% probability that the blood lead concentration in a developing fetus will not exceed 10 μg/dL was determined to between 901 and 1,159 mg/kg. This range is based on the plausible range of soil ingestion input values. Because the range is sufficiently protective, the average within this range (1,030 mg/kg) would provide a reasonable cleanup goal. Although a value of 1,030 mg/kg was derived, rounding down to 1,000 mg/kg provides an additional protection factor for exposure.

The RBRG is likely to be a conservative representation of the soil lead level because the site is covered over 90% of its area with concrete. In addition, during the time critical removal, at least two feet of lead impacted material was removed from all exposed soil areas of the site. Therefore, time critical removal activities have minimized lead exposure conditions in localized areas of the site. However, in those areas where lead impacted soil still are present, concentrations have been determined to exceed 1,000 mg/kg. Because a construction worker would have exposure to subsurface soils during site activities and since excavation of the entire property to this cleanup goal is fiscally infeasible (the entire region is underlain by slag containing lead concentrations), a combination of on-site institutional controls (deed restrictions, contaminant containment, etc.) combined with off-site excavation will provide an effective means of exposure mitigation rendering the exposure pathway incomplete thereby protecting human health.

2.5.5 Uncertainties in Risk Evaluation

Data collected during the investigation was biased to collect the most highly contaminated material both on-site and off-site. Therefore, the site lead concentrations could be considered a worst case representation of lead exposures. The data collected allows an average lead concentration on-site and off-site and assumes that these values represent the complete population distribution of all lead values.

This investigation was not intended as a complete characterization of all lead impacts from all sources to all individuals. There are uncertainties associated with all assessments of risk as not all adults or children will exhibit behavior that will result in the assumed exposures and many methods for reducing or eliminating this exposure are possible. The benchmark blood lead level of 10 μg/dL should not be used as an absolute number since some individuals will exhibit adverse health effects from lead at blood lead levels less than 10 μg/dL while others may not exhibit any adverse effects even at levels greater than 10 μg/dL. This analysis is based on measured environmental levels in the area of concern and does not characterize the actual exposure of any individual.

SITE LOCATION MAP

ENTACT
Leading the Nation in Customer Care

CLEVELAND SOUTH QUADRANGLE OHIO-CUYAHOGA CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)

SCALE 1:24 000

1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 KILOMETER

MN GN

6½° 116 MILS 0°27′ 8 MILS

UTM GRID AND 1984 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929
DEPTH CURVES AND SOUNDINGS IN FEET—DATUM IS LOW WATER 570.5 FEET

Figure 2.1

ENTACT
July 1998

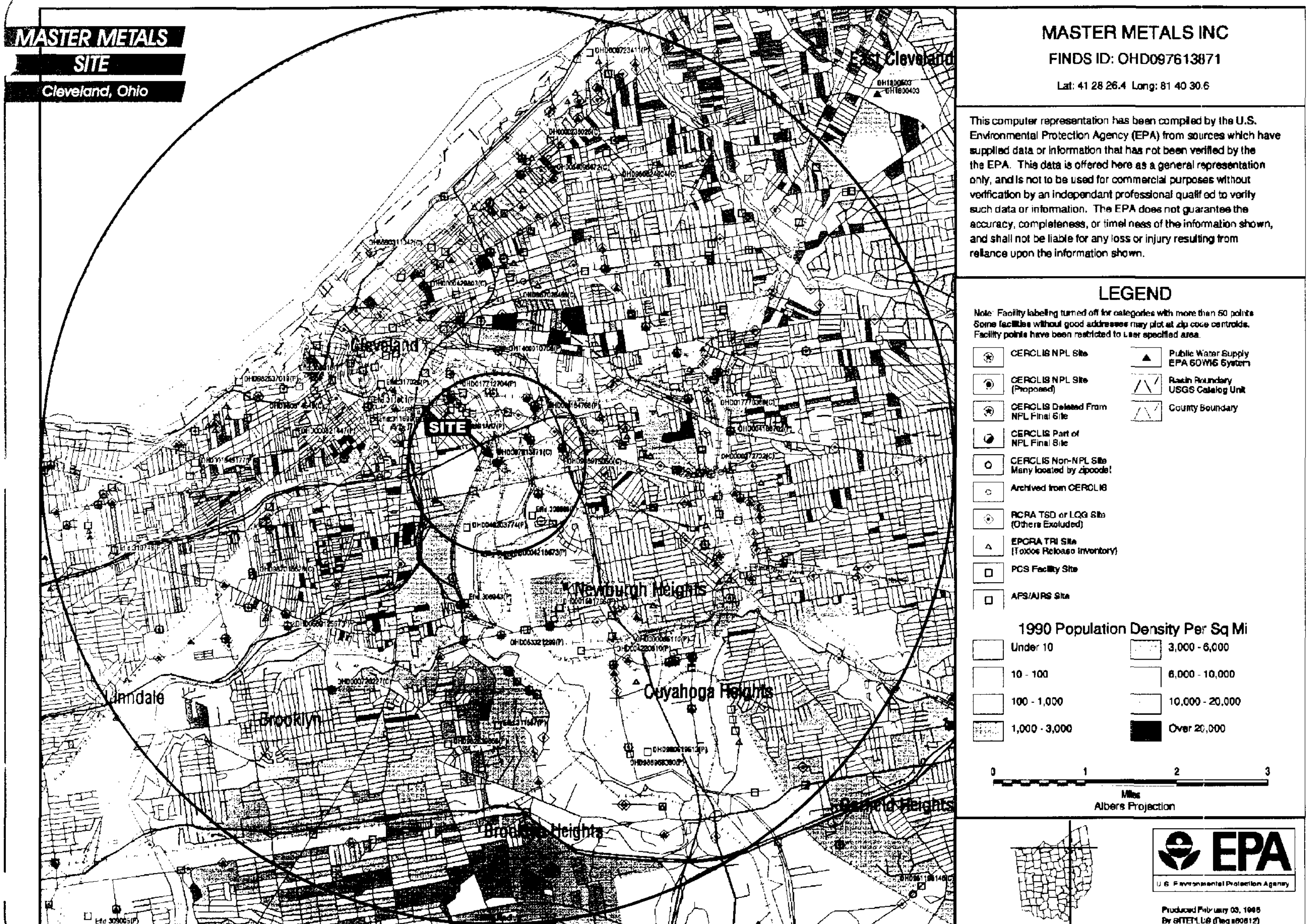


Figure 2.2

1990 POPULATION DENSITY PER SQUARE MILE

MASTER METALS SITE
Cleveland, Ohio

Figure 2.3

HISTORICAL PERIMETER AND ON-SITE SAMPLING LOCATIONS

ENTACT

Description	Sample I.D.	Boring Depth	Total Pb Result (ppm) & Sample Depth (Ft.)
Slag	B-1	Refusal @ 4'	23 (2-3')
Slag	B-2	Refusal @ 4.5'	28 (2-3')
Slag	B-3	Refusal @ 5'	38 (2-3')
Slag	B-4	Refusal @ 5'	36 (2-3')
Brown Sand/Brick	B-5	6" Concrete 10' Sand/Fill	17 (2-3') 18 (8-10')
Slag	B-6	8" Concrete - Refusal @ 4.5'	40 (2-3') 32 (4-5')
Slag	B-7	6" Concrete Refusal @ 5'	2,625 (3')
Slag	B-8	4" Concrete Refusal @ 6'	1,400 (3')
Slag	B-9	4" Concrete Refusal @ 5'	3,825 (3')
Sand/Brick	B-10	12'	970 (3-5') 11,825 (8-10')
Sand/Silty Clay	B-11	10'	11,175 (3-5') 3,500 (8-10')
Sand/Clay	B-12	10'	52 (3-5') 1,200 (8-10')
Sand	B-13	6" Concrete 10'	975 (3-5') 650 (8-10')
Sand/Silty Clay	B-14	6" Concrete 10'	125 (3-5') 105 (8-10')
Sand	B-15	8" Concrete 10'	500 (3-5') 166 (8-10')
Sand/Silty Clay	B-16	10'	15 (3-5') 8 (8-10')
Sand/Silty Clay	B-17	10'	18 (3-5') 33 (8-10')
Sand/Silty Clay	B-18	10'	22 (3-5') 15 (8-10')
Sand/Silty Clay	B-19	10'	128 (3-5') 63 (8-10')
Slag	B-20	Refusal @ 5'	55 (4')
Slag	B-21	4" Concrete 10'	102 (8-10')
Slag	B-22	4" Concrete Refusal @ 5'	352 (3-5')
Slag	B-23	4" Concrete Refusal @ 1.5'	No Information Available
Slag	B-24	6" Concrete Refusal @ 2.5'	4,960 (2')
Sand/Silty Clay	B-25	6" Concrete 10'	5,010 (3-5') 650 (8-10')
Slag	B-26	8" Concrete Refusal @ 7'	1,120 (3-5')
Sand	B-27	6" Concrete Refusal @ 1.5'	14,070 (1')
Slag	B-28	6" Concrete Refusal @ 5'	1,300 (4-5')
Slag/Sand	B-29	6" Concrete Refusal @ 5'	225 (3-5')
Slag/Coal	B-30	6" Concrete 10'	1,260 (3-5') 32 (8-10')
Slag	B-31	Refusal @ 5'	229 (5')
Trench Drain Sediment	SS1	Near Surface	115,000 + TCLP 1,230
Trench Drain Sediment	SS2	Near Surface	8,610 + TCLP 1,040
Surface Soil	SS3	Near Surface	98,000 + TCLP 1,220
Surface Soil	SS4	Near Surface	6,020 + TCLP 3.3
Low Area Sediment	SS5	Near Surface	78,340 + TCLP 959
Surface Soil	SS6	Near Surface	94,000 + TCLP 1,060
Surface Soil	SS7	Near Surface	107,000 + TCLP 1,260
Surface Soil	SS8	Near Surface	24,000 + TCLP 6.3
Surface Soil	SS9	Near Surface	24,200 + TCLP 6.3
Surface Soil	SS10	Near Surface	43,100 + TCLP 757

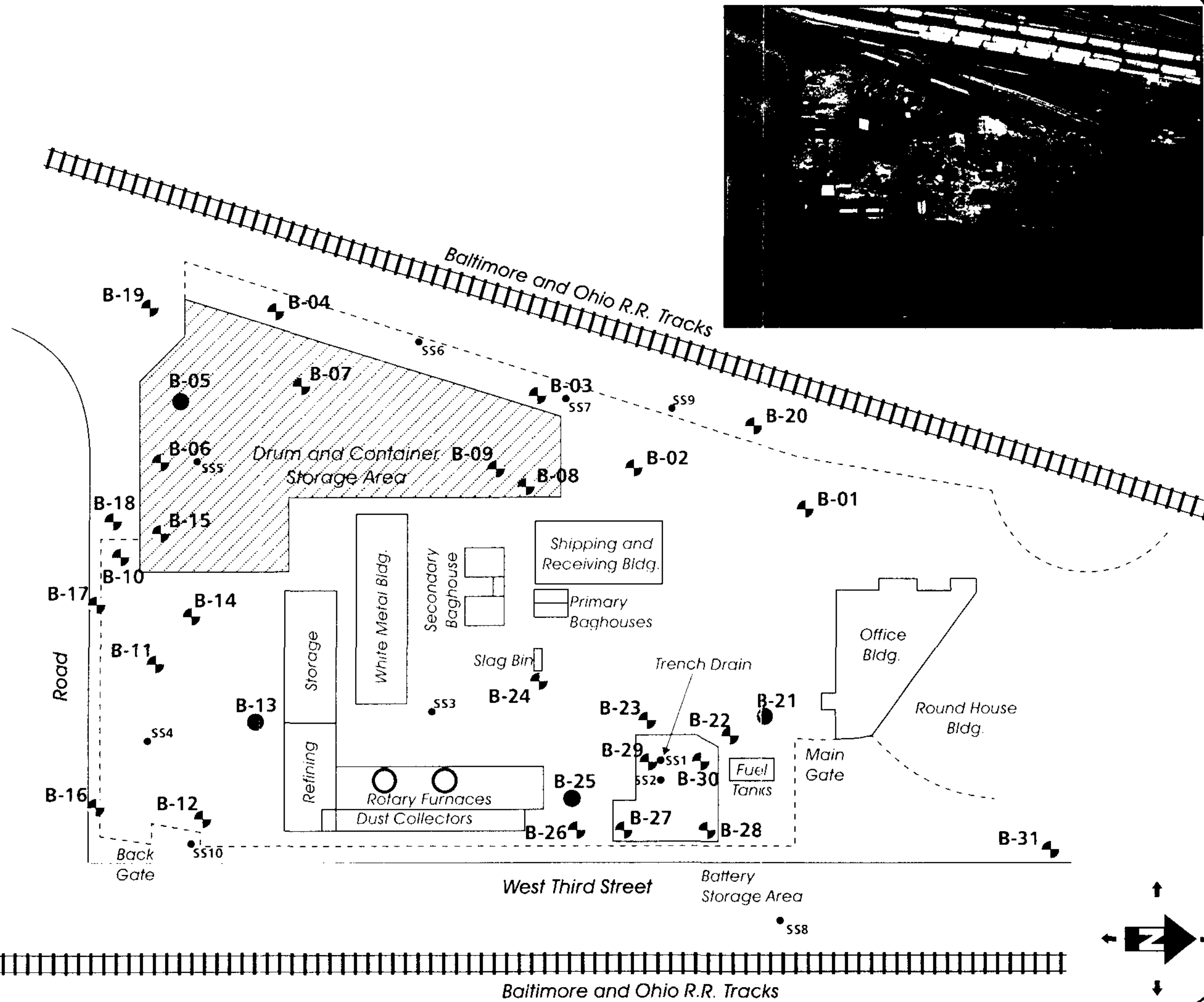
NOTES:

- Site Plan Not To Scale

- Site Features And Boring Locations are Approximate

LEGEND

- Boring Location - CTI; 1990
- Boring Location/Monitoring Well - CTI; 1990
- Surface Grab Sample Location- E & E; 1992
- Fence
- RailRoad Tracks

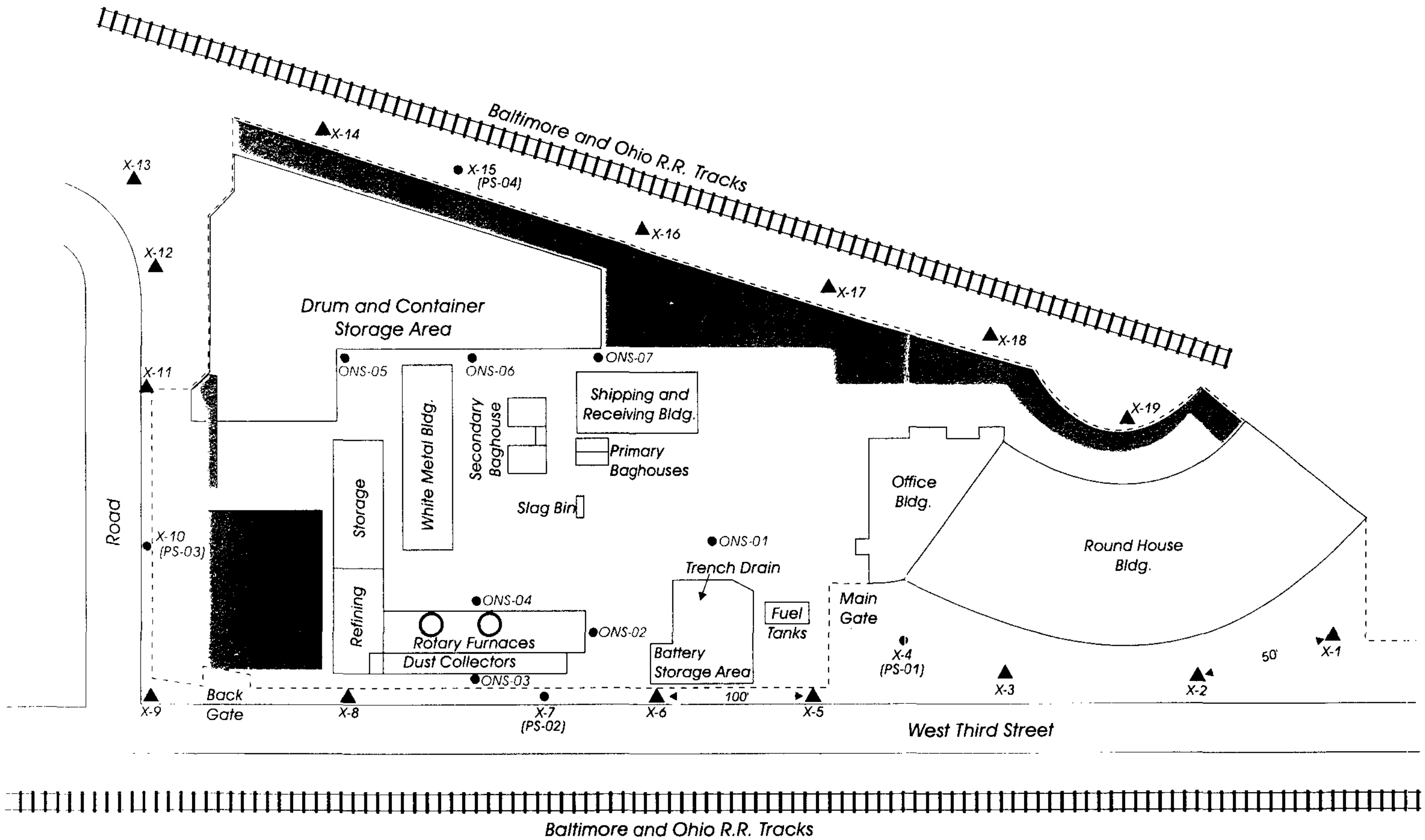


MASTER METALS SITE
Cleveland, Ohio

ENTACT
November 1998

Figure 2.4

EE/CA PERIMETER AND ON-SITE SAMPLING LOCATIONS



NOTES:

- Site Plan Not To Scale
- Site Features, Boring and Sample Locations and Excavation areas are Approximate

LEGEND

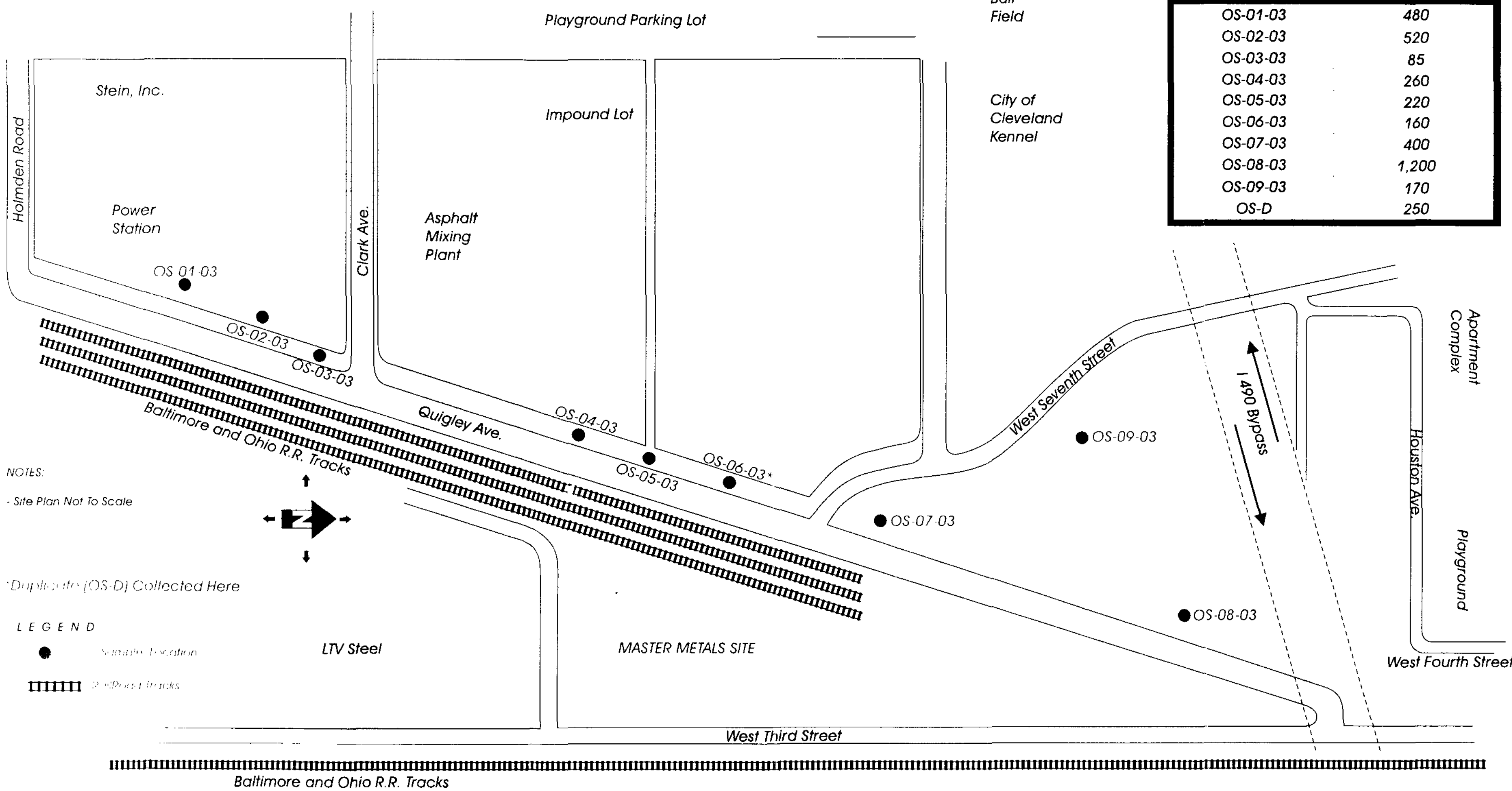
- Phase I Time Critical Excavation
- Boring Location (Boring ID)
- Surface XRF Sample Location
- Fence
- RailRoad Tracks

MASTER METALS SITE
Cleveland, Ohio

Figure 2.5
EE/CA OFF SITE SAMPLE LOCATIONS AND LEAD CONCENTRATIONS (mg/kg)

ENTACT
November 1998

Sample Identification	Lead Concentration (mg/kg)
OS-01-03	480
OS-02-03	520
OS-03-03	85
OS-04-03	260
OS-05-03	220
OS-06-03	160
OS-07-03	400
OS-08-03	1,200
OS-09-03	170
OS-D	250



NOTES:

- Site Plan Not To Scale

*Duplicate (OS-D) Collected Here

LEGEND

● Sample Location

Railroad Tracks

MASTER METALS SITE
Cleveland, Ohio

ENTACT
July 1998

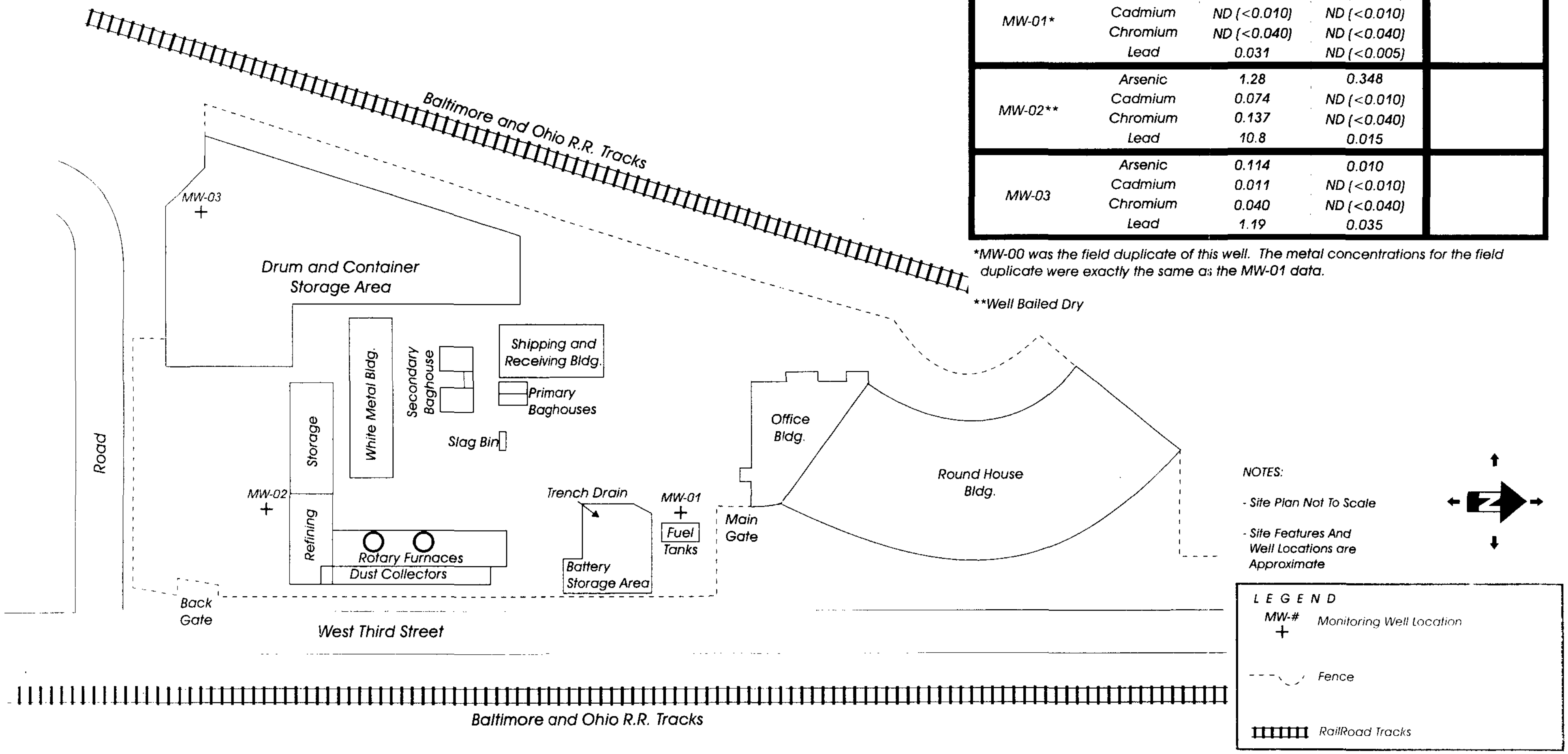
Figure 2.6

EE/CA GROUNDWATER SAMPLING LOCATIONS AND METAL CONCENTRATIONS (mg/kg)

MW-01*	Arsenic	ND (<0.005)	ND (<0.005)	
	Cadmium	ND (<0.010)	ND (<0.010)	
	Chromium	ND (<0.040)	ND (<0.040)	
	Lead	0.031	ND (<0.005)	
MW-02**	Arsenic	1.28	0.348	
	Cadmium	0.074	ND (<0.010)	
	Chromium	0.137	ND (<0.040)	
	Lead	10.8	0.015	
MW-03	Arsenic	0.114	0.010	
	Cadmium	0.011	ND (<0.010)	
	Chromium	0.040	ND (<0.040)	
	Lead	1.19	0.035	

*MW-00 was the field duplicate of this well. The metal concentrations for the field duplicate were exactly the same as the MW-01 data.

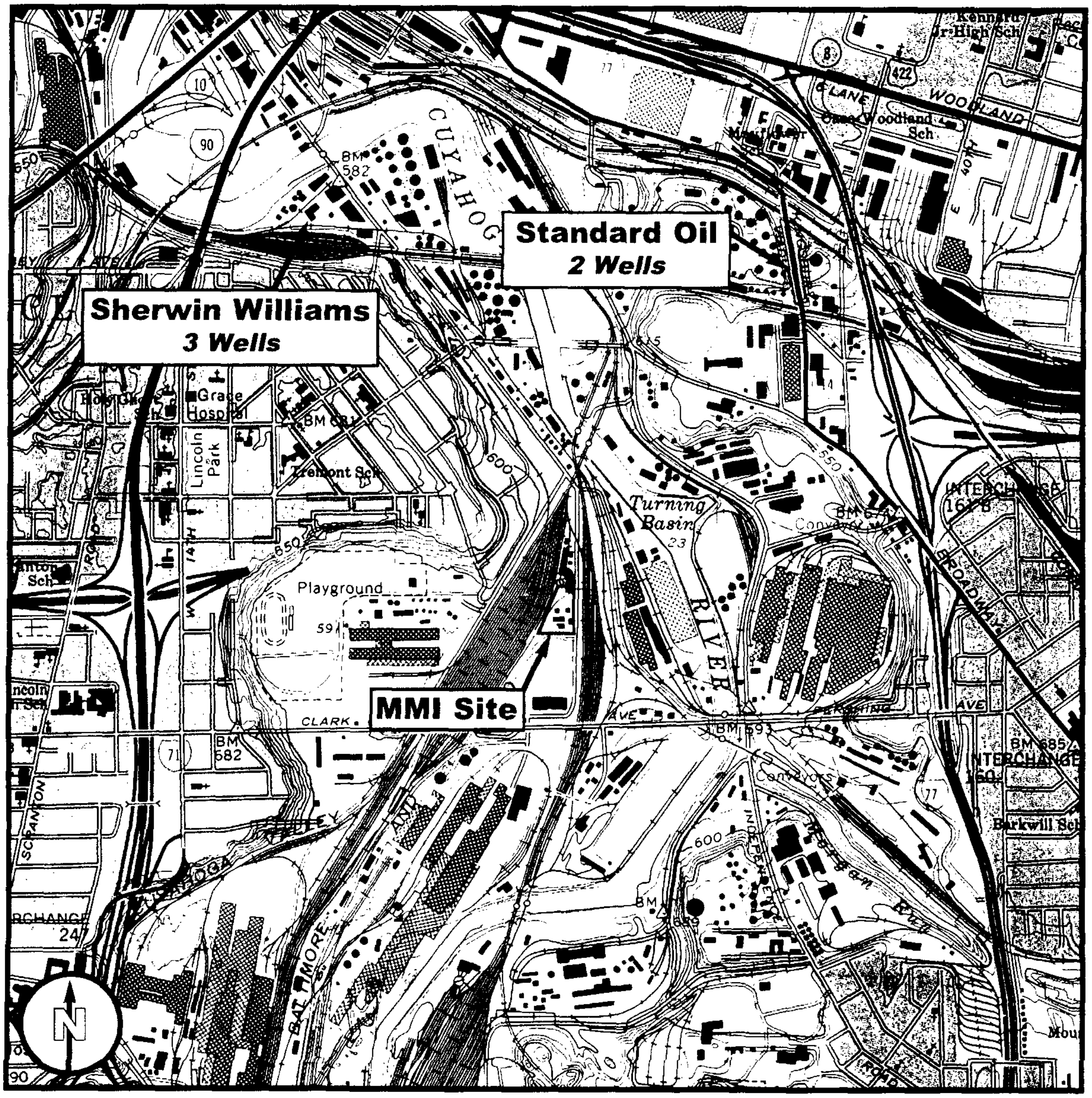
**Well Bailed Dry



WELL LOCATION MAP

ENTACT
Leading the Nation in Customer Care

CLEVELAND SOUTH QUADRANGLE OHIO-CUYAHOGA CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)



SCALE 1:24 000

1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 KILOMETER

CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929
DEPTH CURVES AND SOUNDINGS IN FEET—DATUM IS LOW WATER 570.5 FEET

MN GN
6½° 116 MILS
0°27' 8 MILS

UTM GRID AND 1984 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

Figure 2.7

MASTER METALS SITE
Cleveland, Ohio

ENTACT
November 1998

Figure 2.8

SITE CONCEPTUAL EXPOSURE MODEL (SCEM)

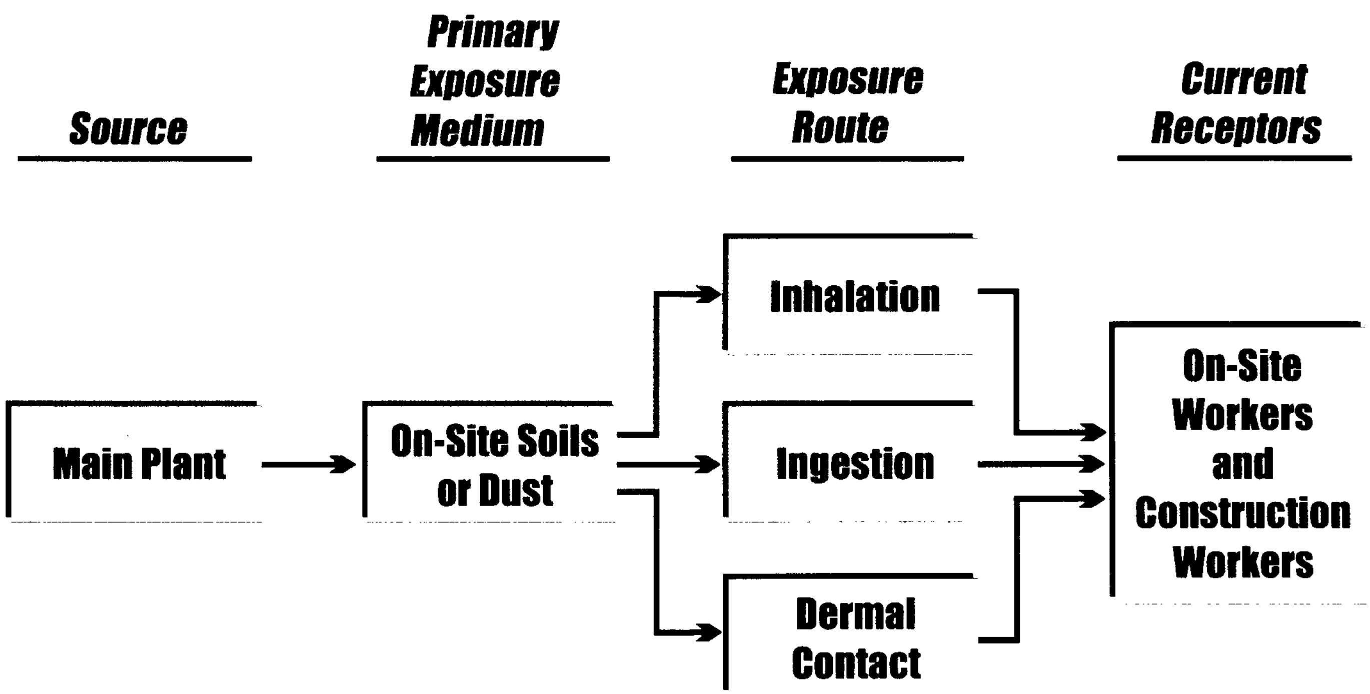


TABLE 2.1

PERIMETER XRF SAMPLES

SAMPLE ID	LOCATION	TOTAL Pb XRF RESULTS (ppm) 1	2	3	AVERAGE
X-1	E border N end	1620	1520	1336	1492
X-2	E border N end	1460	1076	2040	1525
X-3	E border N end	1520	1660	2110	1763
X-4	E border N end	3170	3380	3530	3360
X-5	E border central	4010	5480	5180	4890
X-6	E border central	7280	3050	7970	6100
X-7	E border central	9340	10220	11360	10307
X-8	E border south end	570	1573	650	931
X-9	E border south end	4330	3840	4320	4163
X-10	South border east corner	44060	24430	41270	36587
X-11	South border east central	19400	16070	22930	19467
X-12	South border central	13840	10960	13040	12613
X-13	South border west central	3700	2810	3520	3343
X-14	South border west corner	1750	3760	5310	3607
X-15	West border south end	8820	26970	27920	21237
X-16	West border central	11570	15330	20340	15747
X-17	West border central	5570	7340	7140	6683
X-18	West border north end	3080	2065	6280	3808
X-19	West border north end	7100	6880	6990	6990

TABLE 2.2
BORING SCREENING RESULTS

BORING ID	TOTAL DEPTH (Ft)	RECOVERY	INTERVAL (* lab verified)	Total Pb XRF RESULTS (ppm) 1	2	3	AVERAGE	DESCRIPTION
PS-01	4'	2'8"						
			0-6"	5840	5890	4660	5463	brown/black coarse sand and gravel.50% coarse sand, 50% coarse grave
			6-12"	1114	1295	3190	1866	black silty sand
			12-24" *	73	67	76	72	12-18" - black coal, 18-24" - brown fine-med.sand/little silt
			24-36"	ND	ND	ND	ND	brown/black gravelly crushed slag with large (1-3" dia.) black/gray porous slag fragments
PS-02	3'	1'10"						
			0-6"	4380	5480	6250	5370	tan/brown med. Sand and fine gravel. 60% med.sand 40% gravel
			6-12"	6760	5670	6280	6237	black/brown silty sand with slag fragments (>1' dia.)
			12-22" *	490	372	366	409	12-16" brown silty med.sand. 16-22" black crushed slag with slag fragments
PS-03	4'	4'						
			0-6"	7840	5160	8230	7077	brown silty med.sand with slag fragments
			6-12"	5570	2720	6530	4940	brown sandy silt with small rock fragments with organic mat. (roots, grass)
			12-24" *	310	445	370	375	brown sandy silt with some clay. Small coal and brick fragments
			24-36"	58	39	32	43	brown sandy silt some clay
			36-48"	ND	22	59	<50	brown sandy silt some clay
PS-04	4'	4'	0-6"	3220	5060	4400	4227	black silty med. Sand. 10% rock fragments
			6-12"	1087	3490	3060	2546	black silty med.sand. 5% rock fragments
			12-24"	1339	1440	869	1216	black silty med. Sand. 5% rock fragments
			24-36" *	115	122	106	114	black silty med. Sand and crushed fine black slag (30%)
			36-48"	253	184	238	225	black silty med. Sand and crushed fine black slag (30%)

TABLE 2.2
BORING SCREENING RESULTS

BORING ID	TOTAL DEPTH (Ft)	RECOVERY	INTERVAL (* lab verified)	Total Pb XRF RESULTS (ppm) 1	2	3	AVERAGE	DESCRIPTION
ONS-01	2'	approx 1 5'						
			0-6"	9170	13460	8670	10433	coarse sand and gravel with large rock fragments (>1" dia.) 30% rock fragments
			6-12"	6400	8470	8340	7737	brown coarse sand and gravel with 20% blue/gray slag fragments and brick
			12-18" *	9560	15180	13000	12580	12-14" brown sandy silt. 14-16" blue/gray porous slag fragments (>1in. Dia.)
ONS-02	4'	approx 2.5'						
			0-6"	5700	5630	7860	6397	brown sandy silt with <5% slag fragments
			6-12"	1253	1584	1260	1366	brown/black med-course sand with some silt. Black slag fragments <5%
			12-24" *	439	443	354	412	black coarse sand with some silt. 10% orange brick (>2in. Dia.) 5% white/black porous slag and small coal fragments
			24-36"	96	173	293	187	black coarse sand with 30% light yellow porous slag with shale fragments and brick
ONS-03	4'	approx 3'						
			0-6"	23220	33510	28770	28500	black coarse sandy silt with <10% gray porous slag material
			6-12"	8670	8700	11850	9740	brown sandy silt with some clay and small shale fragments
			12-24" *	436	670	640	582	brown/orange clayey silt <5% gray slag fragments
			24-36"	553	554	284	464	24-30" dark brown coarse sand. 30-36" slag fragments (>1" dia.)
ONS-04	4'	approx 3'						
			0-6"	12800	11190	12210	12067	brown silty sand with <20% brick
			6-12" *	439	566	381	462	brown sandy clay with <5% black slag and rock fragments
			12-24"	33	54	69	52	brown/tan sandy silt with small slag fragments (<5%)
			24-36	818	1640	2350	1603	black to dark red coarse sand(40%) and silt(50%). 10% red brick and large gray slag fragments (>1" dia.)

TABLE 2.2
BORING SCREENING RESULTS

BORING ID	TOTAL DEPTH (Ft)	RECOVERY	INTERVAL (* lab verified)	XRF RESULTS Total Pb (ppm) 1	2	3	AVERAGE	DESCRIPTION
ONS-05	4'	approx 2 5						
			0-6"	5070	15600	9910	10193	black/brown sand and gravel with some gray slag fragments (10%)
			6-12"	4600	3500	7160	5087	light gray to black sand with slag fragments (50%)
			12-24" *	4990	2510	4870	4123	crushed gray/black slag with large fragments(>1 in. dia.)
ONS-06	4'	approx 2 5'						
			0-6" *	76	95	158	110	brown silty sand with small gray slag fragments (<5%)
			6-12"	17640	19180	9240	15353	black to gray sand and gravel size slag with large black slag fragments
			12-24"	1840	2240	3070	2383	12-18" large (>2in dia.) black slag fragments with fine gravel. 18-24" coarse black gravel and sand (wet) exhibits oily appearance and odor. 18-24" not analyzed with XRF due to high moisture content
ONS-07	2 5'	approx 2'						
			0-6"	36830	25850	40280	34320	brown silty sand with small slag fragments (+ battery component terminal. Boring taken at a location absent of concrete
			6-12"	1310	1230	1834	1458	brown sandy silt with some gravel(10%)
			12-24" *	3550	4270	7700	5173	brown sandy clay with 50% brick and slag

TABLE 2.3

LABORATORY VERIFICATION DATA

PERIMETER SAMPLES

SAMPLE ID	LABORATORY CONCENTRATIONS (MG/KG) ARSENIC	CADMIUM	CHROMIUM	LEAD
PS-01-24	7.4	0.74	12	68
PS-02-24	7.8	1.7	390	870
PS-03-24	11	1.2	9.8	340
PS-04-36	6.6	0.83	12	100
PS-04-D	4.6	0.57	7.9	63
PS-D	10	1.1	9.6	360

ON-SITE SAMPLES

SAMPLE ID	LABORATORY CONCENTRATIONS (MG/KG) ARSENIC	CADMIUM	CHROMIUM	LEAD
ONS-01-24	80	44	19	28,000
ONS-02-24	7.9	82	9.5	460
ONS-03-24	61	51	9	2,000
ONS-04-12	59	57	14	12,000
ONS-05-24	67	24	23	11,000
ONS-06-06	8	220	7.9	240
ONS-07-24	100	23	16	22,000
ONS-D	8	160	7.4	250

TABLE 2.4
COMPARISON OF XRF TOTAL LEAD VALUES TO LABORATORY TOTAL LEAD VALUES

PERIMETER SOIL SAMPLES

SAMPLE ID	XRF Total Pb (ppm)	LABORATORY Total Pb (ppm)
PS-01-24	72	68
PS-02-24	409	870
PS-03-24	375	340
PS-04-36	114	100

ON-SITE SOIL SAMPLES

SAMPLE ID	XRF Total Pb (ppm)	LABORATORY Total Pb (ppm)
ONS-01-24	12580	28000
ONS-02-24	412	460
ONS-03-24	582	2000
ONS-04-12	462	12000
ONS-05-24	4123	11000
ONS-06-06	110	240
ONS-07-24	5173	22000

3.0 IDENTIFICATION OF REMEDIAL ACTION OBJECTIVES

3.1 Remedial Action Objectives

Under CERCLA, the removal action objectives for a source area are based on exposure levels and associated risks posed by on-site contamination that may migrate from the source areas. Based on the results of surficial soil sampling conducted at the MMI Site and on the outside perimeter of the facility, it is likely that the facility has contributed to the lead contamination around the near site perimeter through windblown and fugitive dust.

The remedial action objectives for the MMI Site are as follows:

- Prevent ingestion of surface soil in excess of federal and state soil standards or criteria, or that pose a threat to human health; and

- Prevent inhalation of airborne contaminants from surface soils in excess of federal and state air standards or criteria, or which may present a threat to human health.

3.2 Applicable or Relevant and Appropriate Requirements (ARARs)

The remedies for the Master Metals site are subject to federal Applicable or Relevant and Appropriate Regulations (ARARs) and any more stringent state regulations. The determination of ARARs have been made in accordance with 121(d)(2) of CERCLA, as amended by the Superfund Amendments Reauthorization Act (SARA) of 1986. These ARARs are also consistent with the National Contingency Plan (NCP) 40 CFR Part 300; amended March 8, 1990. ARARs are federal, or more stringent state requirements, that the alternative(s) must achieve, that are legally applicable to the substance or relevant and appropriate under the circumstances.

The status of a requirement under Section 121(d) of CERCLA and other environmental laws, both federal and state, may be either applicable or relevant and appropriate to the removal alternative, but not both. The NCP (40 CFR 300.5) defines these terms as follows:

- Applicable requirements are those clean-up standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, removal action, location, or other circumstances found at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable.

- Relevant or appropriate requirements are those clean-up standards, standards of control, and other substantive requirements, criteria or limitations described above, that, while not applicable, address problems or situations sufficiently similar to those encountered at a

CERCLA site that their use is well-suited to the particular site.

ARARs are divided into three types of requirements: chemical specific, location specific, and action specific. This distinction is based on the factors that trigger the requirement (e.g., emission of a chemical or a particular action such as transportation of a chemical). These types of ARARs are defined as follows:

- Chemical specific requirements set health or risk-based concentration limits or ranges in various environmental media for specific hazardous substances, pollutants or contaminants that are acceptable in the ambient environment. Examples of chemical specific ARARs are National Ambient Air Quality Standards.

- Location specific requirements set restrictions on activities depending on the characteristics of a site or its immediate receptors. A remedial alternative may be restricted or eliminated due to the location or characteristics of the site and the requirements that apply to it. Examples of locations specific ARARs are construction requirements for air permitting.

- Action specific requirements set controls or restrictions on particular kinds of activities related to the management of hazardous substances, pollutants, or contaminants. These requirements are not triggered by specific chemicals at a site, but rather by the particular activities to be conducted during the implementation of the removal alternative (i.e. technology or activity based requirements).

Only chemical specific ARARs are candidates for site clean-up goals. Action specific and location specific ARARs apply to the execution of the selected removal alternative.

In addition, criteria, advisories, or guidance documents that are not considered an ARAR, but may assist in determining what is necessary to be protective or otherwise useful in developing Superfund remedies are described as information to be considered (TBC). Three general categories of TBCs are 1) health effect information with a high degree of credibility; 2) technical information on how to perform or evaluate site investigations or response actions, and 3) policy. The 1990 amendments to the NCP emphasize that the TBCs are to be used on an "as appropriate" basis and are intended to complement the use of ARARs.

3.2.1 Identification of Potential Federal ARARs for the Master Metals Site

This section presents a summary of those federal regulations which may be found to be applicable or relevant and appropriate to the MMI Site:

- The Comprehensive Environmental Response, Compensation, and Liability Act

CERCLA, last amended in October 1992, provides the U.S. EPA Administrator the authority to respond to any past disposal of hazardous substances and any new uncontrolled releases of hazardous substances. Within CERCLA, a trust fund has been established for clean-up of abandoned past disposal sites and leaking underground storage facilities, as well as the authority to bring civil actions against violators of this act. The National Contingency Plan (NCP), which guides clean-up actions at Superfund sites, was developed subject to this act.

The Superfund Amendments and Reauthorization Act (SARA) of 1986 extensively amends CERCLA. The major goals of SARA were to include more public participation, and to establish more consideration of State clean-up standards, with an emphasis on achieving remedies that permanently and significantly reduce the mobility, toxicity, or volume of wastes.

The preamble to the NCP (55 FR 8758-8760, March 8, 1990) discussed the issue of movement of hazardous waste within an area of generally dispersed contamination (AOC) and stated that this activity would not be considered RCRA land disposal. The MMI Site and the off-site areas as stated in Section 2.11 of the EE/CA can be viewed as an AOC. Therefore, movement of off-site materials onto the MMI Site would not be considered RCRA land disposal and would not trigger the RCRA land disposal restrictions.

- The Resource Conservation and Recovery Act

RCRA regulates the management and land disposal of hazardous waste and solid waste material and the recovery of materials and energy resources from the waste stream. RCRA regulates the generation, transportation, treatment, storage, and disposal of hazardous wastes, as well as solid waste disposal facilities. RCRA applies to removal actions selected that include disposal, treatment, storage, or transportation of regulated wastes. Remedies that include on-site disposal of hazardous wastes will be required to meet RCRA design, monitoring, performance and closure standards. Off-site transportation of regulated wastes, whether as part of a removal action or as generated during the investigation, will require use of the manifest system, a RCRA-licensed transporter, and proof of acceptance at a licensed facility approved for the particular wastes.

The Hazardous and Solid Waste Act Amendments (HSWA) impose new and more stringent requirements on hazardous waste generators, transporters, and owner/operators of treatment, storage, and disposal facilities. Land disposal restrictions, as described in 40 CFR 268, identify hazardous wastes that are restricted from land disposal and define those limited circumstances under which an otherwise prohibited waste may continue to be land disposed.

- The Clean Air Act

The Clean Air Act (CAA), was enacted to protect and enhance the quality of air resources to protect the public health and welfare. The CAA is intended to initiate and accelerate national research and development programs to achieve the prevention and control of air pollution. Under the CAA, the Federal Agencies are to provide technical and financial assistance to state and local governments for the development and execution of their air pollution programs. The U.S. EPA is the administrator of the Act and is given the responsibility to meet the objectives of the Act. The Act establishes emission levels for certain hazardous air pollutants that result from treatment processes.

Requirements of the CAA are potentially applicable to removal actions that result in air emissions, such as excavation activities.

3.2.2 Identification of Potential State ARARs for the Master Metals Site

The purpose of this section is to identify ARARs that exist based on Ohio state regulations that must be complied with when performing a removal action. The agency charged with developing and enforcing environmental regulations for Ohio is the Ohio Environmental Protection Agency (OEPA).

- Ohio Solid Waste Rules

These regulations specify requirements that apply to solid waste and hazardous waste facilities. These include Solid Waste Management Requirements, Hazardous Waste Management Permit Program and Related Hazardous Waste Management Requirements. The solid waste regulations include design and disposal regulations. The hazardous waste regulations were developed pursuant to the requirements of RCRA and pertain to generators and transporters of hazardous waste and owners or operators of hazardous facilities.

- Ohio Water Quality Standards

These regulations pertain to all waters in the state and are intended to restore and maintain the chemical, physical, and biological integrity of the waters of the state. The regulations include:

- Specific water quality standards and minimum treatment requirements that apply to all waters of the state. These include minimum surface water quality standards; and

- Water quality standards for water distribution through public water systems.

The procedures for developing water quality criteria based on toxicity are procedures for evaluating the characteristics of receiving waters. These procedures are used to determine discharge concentrations which if not exceeded will maintain the quality of the receiving waters.

- Ohio Voluntary Action Program Rule

The Ohio VAP Rule were developed for investigation, identification, and remediation of hazardous substances or petroleum. The rules establish specific procedures for investigation activities and generic numerical standards (e.g., concentrations) for hazardous substances or petroleum that ensure protection of public health and safety and the environment.

- Ohio Air Pollution Control Regulations

The Ohio air pollution control regulations were developed pursuant to the Federal CAA. The regulations contain specific emission levels and requirements for monitoring emissions. They contain requirements for specific types of operations (such as burning) and for types of industry. There are also specific emissions standards for hazardous air pollutants.

3.2.3 Chemical-Specific Requirements

- Federal

(1) Clean Air Act (42 USC 7401 et seq.), National Primary and Secondary Ambient Air Quality Standards (40 CFR 50) [U.S. EPA regulations on National Primary and Secondary Ambient Air Quality Standards].

(2) Solid Waste Disposal Act, as amended (42 USC 6901, et seq.), Land Disposal Restrictions (40 CFR 268) Subpart D, Treatment Standards [Sets the treatment standards for waste extract, specified technology, hazardous waste].

(3) Solid Waste Disposal Act, (15 USC 6901, et seq.), Identification and listing of Hazardous Waste (40 CFR 261) Subpart B, Criteria for Identifying the Characteristics of Hazardous Waste and for Listing Hazardous Waste [Sets criteria for identifying a hazardous waste].

(4) Solid Waste Disposal Act, (15 USC 6901, et seq.), Identification and Listing of Hazardous Waste (40 CFR 261) Subpart C, Characteristics of Hazardous Waste [Identifies the characteristics of a hazardous waste].

(5) Solid Waste Disposal Act, (15 USC 6901, et seq.), Identification and Listing of Hazardous Waste (40 CFR 261) Subpart D, List of Hazardous Waste [List of hazardous waste from sources].

- State

(6) Ohio Air Pollution Control Laws, (Title 37 ORC Chapter 3704), Prohibition of emission of air contaminants (ORC 704.06) [May pertain to a site where contaminant air emissions may occur as a result of the selected remedy].

(7) Ohio Air Pollution Control Laws, (Title 37 ORC Chapter 3704), General requirements for Ohio Air Conservation Rules (ORC 3745-15) [General requirements and definitions which may be applicable during remediation strategies which include pollutant emissions].

3.2.4 Location-Specific Requirements

- State

(8) Ohio Solid and Hazardous Waste Law (Title 37 ORC Chapter 3734), Digging where hazardous or solid was is located (ORC 3734.02)[Pertains to any site where solid or hazardous waste has come to be located and where excavation activities will uncover solid or hazardous waste].

(9) Ohio Air Pollution Control Laws, (Title 37 ORC Chapter 3704), Air emissions from hazardous waste facilities (ORC 704.02)[Pertains to any site at which hazardous waste will be managed such that air emissions may occur].

3.2.5 Action-Specific Requirements

- Federal

(10) Clean Air Act, (42 USC 740 et seq.), National primary and Secondary Ambient Air Quality Standards (40 CFR 50) [Specifies maximum primary and secondary 24-hour concentrations for particulate matter].

(11) Solid Waste Disposal Act, as amended (42 USC 6901, et seq.), Guideline for the Land Disposal of Solid Wastes (40 CFR 241), Part B - Requirements and Recommended Procedures [Solid, nonhazardous wastes generated as a result of remediation must be managed in accordance with federal and state regulations; this is applicable to waste generated by the removal action].

(12) Solid Waste Disposal Act, as amended (42 USC 6901, et seq.), Standards for Hazardous Waste Generators (40 CFR 262); [General requirements for manifesting hazardous wastes for temporary storage and transportation off-site]. Any residues determined to be RCRA hazardous waste destined for off-site disposal are subject to manifest requirements. Remedial actions involving off-site disposal of RCRA listed wastes will be subject to this requirement.

(13) Solid Waste Disposal Act, as amended (42 USC 6901, et seq.), Land Disposal Restriction-RCRA (40 CFR 268) [RCRA Land Disposal Restriction, defines hazardous waste. This requirement is applicable to those RCRA hazardous wastes that will be disposed off-site.

(14) Solid Waste Disposal Act, as amended (42 USC 6901, et seq.), Standards for Owners and Operators of Hazardous Waste Treatment Storage, and Disposal Facilities (40 CFR 264), Subpart I, Use and Management of Containers; Subpart J, Tank Systems:Subpart L, Waste Piles:[Containers used to store hazardous waste must be closed an in good condition. Tank systems must be adequately designed and have sufficient structural

strength and compatibility with the wastes to be stored or treated to ensure that it will not collapse, rupture, or fail, including secondary containment. Waste piles must be designed to prevent migration of wastes out of the pile into adjacent subsurface soil or groundwater or surface water at any time during its active life].

(15) Solid Waste Disposal Act, as amended (42 USC 6901, et seq.), Standards for Owners and Operators of Hazardous Waste Treatment Storage, and Disposal Facilities (40 CFR 264), Subpart D, Containment Building. [Hazardous waste may be placed in units known as containment building for the purpose of interim storage or treatment].

- State

(16) Ohio Solid and Hazardous Waste Law (Title 37 ORC Chapter 3734), Definitions and general requirements for solid and hazardous waste management (3745-50)[General requirements and definitions applicable for the management of solid and hazardous waste].

(17) Ohio Solid and Hazardous Waste Law (Title 37 ORC Chapter 3734), Hazardous waste storage and/or treatment in tanks (ORC 3745-50-44)[Pertains to any site at which treatment of hazardous waste in a tank will be used to treat waste on-site].

(18) Ohio Solid and Hazardous Waste Law (Title 37 ORC Chapter 3734), Requirements for generators of solid/hazardous waste (ORC 3745-52)[Pertains to sites at which either solid and/or hazardous waste are located].

(19) Ohio Solid and Hazardous Waste Law (Title 37 ORC Chapter 3734), Land Disposal Restrictions (ORC 3745-59)[Any hazardous generated during excavation is subject to land disposal restrictions].

(20) Ohio Solid and Hazardous Waste Law (Title 37 ORC Chapter 3734), Land Disposal Restrictions (ORC 3745-55-19)[Deed restriction notification to local land authorities for hazardous waste disposal].

(21) Ohio Solid and Hazardous Waste Law (Title 37 ORC Chapter 3734), Land Disposal Restrictions (ORC 3745-66-19)[Post-closure notice of hazardous waste disposal].

3.2.6 Other Requirements to be Considered (TBCs)

- Federal

(22) Occupational Safety and Health Administration Standards (29 CFR 1910: 1910.1000), Subpart Z. Toxic and Hazardous Substances [Sets worker exposure limits to toxic and hazardous substances and prescribes the methods for determination of concentrations].

(23) Occupational Safety and Health Administration Standards (29 CFR part 1926) [Specifies the type of safety equipment and procedures to be followed during site remediation].

(24) Occupational Safety and Health Administration Standards Recordkeeping, Reporting and Related Regulations (29 CFR 1904) [Establishes Record keeping and reporting requirements for an employer under OSHA].

3.3 Remedial Scope

The surficial soils around the Master Metals Site present a potential risk to human health. An assessment of the risk is discussed in detail in Section 2.5.

As discussed in the streamlined risk evaluation, perimeter surface soil adjacent to the Master Metals Site is impacted by lead at levels greater than the target cleanup goal of 1,000 mg/kg. This level of lead in the surficial soils was determined to pose a potential threat to on-site and off-site construction workers. The overall objective of the remedial action for the site is to eliminate the risks caused by levels of lead exceeding the target cleanup goal of 1,000 mg/kg in the surficial soils.

3.4 Project Schedule

For the purposes of planning a non-time critical remedial action at the MMI site, it is reasonable to anticipate completion of remedial activities in six to twelve months depending on the remedy selected. This schedule assumes commencement of removal activities within one month and project duration of five to eleven months. Schedule and implementability issues for potential removal alternatives will be further discussed is Section 4.

4.0 IDENTIFICATION AND ANALYSIS OF REMOVAL ACTION ALTERNATIVES

During Phase I of the Time-Critical Removal Actions that occurred during the summer of 1997, all standing structures were decontaminated and demolished down to concrete slab elevation. Resulting scrap debris was decontaminated and recycled off-site. Additionally, all soils surrounding the concrete slab up to the property fence line, were excavated to a depth of two feet or until slag/fill material was reached. This material was then subsequently treated and disposed of off-site. All excavated/exposed areas were covered with approximately six inches of sand to mitigate any exposure to contaminants.

Based on data generated during the EE/CA Data Report, January 1998, surficial contamination still exists at the MMI site outside of the property's fence line and below some areas of concrete slab. The vertical limit of contamination is approximately two feet below ground surface. However, most of the site contamination occurs shallower than this depth.

Several alternatives were reviewed prior to selecting the final four (4). Section 4.0 will identify and analyze these selected four (4) removal action alternatives. The alternatives emphasize perimeter excavation of surficial contamination and "cap and containment" integrity to focus on eliminating inhalation and ingestion exposure pathways. These alternatives include a "no action" alternative for baseline comparison.

4.1 Development of Alternatives

Each alternative was developed based on a streamlined approach which utilizes best engineering and field judgment to identify the more appropriate and feasible alternatives for meeting site remedial objectives. A systematic and qualitative comparison of each alternative is performed to identify the most effective and appropriate removal action.

The streamlined development of alternatives is justified since the objectives of the remedial approach are limited. Contaminant related remedial action objectives are limited to a single media source (surface soils).

A summary profile of each alternative is presented below. Subsequently, each alternative is evaluated against the following criteria:

- Overall Protection of Public Health and the Environment
- Compliance with ARARs and Other Criteria, Advisories, and Guidance
- Long-Term Effectiveness and Permanence
    - Magnitude of Residual Risk
    - Adequacy and Reliability of Controls
- Reduction of Toxicity, Mobility, or Volume Through Treatment
- Short-Term Effectiveness

- Protection of the Community
    - Protection of the Workers
    - Environmental Impacts
    - Time Until Response Objectives are Achieved
- Implementability
    - Technical Feasibility
    - Administrative Feasibility
    - Availability of Services and Materials
- State Acceptance
- Community Acceptance
- Cost
    - Direct Capital Costs
    - Indirect Capital Costs
    - Long-Term Operation and Maintenance

It should be noted that State Acceptance and Community Acceptance are criteria which can only be assessed following comment of the EE/CA report through both OEPA review and public comment. Therefore, these two criteria will not be considered at this time.

4.2 Proposed Removal Action Alternatives

Alternative 1 - No Action

Alternative 2 - Off-site Excavation, On-site Consolidation, On-site Cover, Operation & Maintenance (O & M)

Alternative 3 - Off-site Excavation, On-site Consolidation, On-site Capping, O & M

Alternative 4 - Off-site Excavation, Treatment, Off-site Disposal, On-site Capping, O & M

4.3 Evaluation of Proposed Removal Action Alternatives

4.3.1 Alternative 1 - No Action

Under this proposed alternative, no further action measures would be taken to remediate the site other than the activities already completed during the Phase I Time Critical Removal Actions during the summer of 1997. Site security would be implemented by ensuring the existing chain link fence was sufficient to prohibit access to the property and that "No Trespass" signs were visible on the fence.

- Overall Protection of Public Health and the Environment

Alternative 1 would provide only limited protection of public health and the environment. Lead contamination in surficial soils along the exterior of the eastern and southern fence lines of the property would continue to pose a risk through the potential for ingestion or inhalation of contaminants. Additionally, the property contains numerous slip, trip, and fall hazards, as well as open pits, sumps, and excavated areas. As a result, illegal entry into the site poses numerous dangers.

- Compliance with ARARs and Other Criteria, Advisories, and Guidance

This alternative would not comply with ARARs. No additional action would be taken to eliminate reduce or control the lead contamination in the solid media in the off-site or on-site areas. Natural attenuation would have little or no long term effect on this situation.

- Long-Term Effectiveness and Permanence

Alternative 1 would not be effective in eliminating potential exposure pathways and inherent dangers on the property. All of the currently identified mechanisms for exposure would remain. Natural attenuation would not provide a significant mechanism for reduction of exposure risks to lead contamination.

- Reduction of Toxicity, Mobility, or Volume Through Treatment

Since Alternative 1 does not include any treatment options, there would be no reduction of toxicity, mobility, or volume.

- Short-Term Effectiveness

Since Alternative 1 takes no additional action, it would not have any short term effectiveness on the community, workers, or environment.

- Implementability

This criterion would not be applicable to this alternative, as there are no actions to implement.

- Alternative 1 Costs

There is no cost to implement this alternative.

4.3.2 Alternative 2 - Off-site Excavation, On-site Consolidation, On-site Cover, Operation & Maintenance (O & M)

Under Alternative 2, off-site contaminated soils would be excavated to 1,000 mg/kg or until the original historical slag fill which was deposited in this area in the 1900s is encountered and consolidated on-site. The material will be tested to determine if treatment is required prior to consolidation. A two foot cover will be placed over all contaminated areas, thereby eliminating the potential of inhalation or ingestion from these contaminated soils. Additionally, site dangers such as open pits and sumps will have been eliminated.

Off-site excavation of contamination will require the removal and subsequent replacement of the entire site fencing. Additionally, all off-site areas will require clearing and grubbing. Both measures are necessary to effectively excavate all contamination. All site fencing will be replaced with industrial grade fence topped with three strands of barb wire.

The off-site areas will extend outward from the eastern, western, and southern boundary lines of MMI. Existing structures will limit the areas of excavation around the site perimeter. For example, railroads exist on the east and west sides of the facility. Railroad ballast has historically been shown to contain lead and other heavy metals originating from jernal bearing leakage. Because the railroad tracks are currently in use and because the site contamination has been commingled with other anthropogenic sources of contamination, it is not practical to excavate around these structures. In addition, the area between the western portion of the facility property and Quigley Avenue is comprised of railroad tracks. Therefore, the off-site areas will extend outward as follows: the eastern and southern off-site area will extend outward from the property line and end at the existing concrete curb of West Third Street; the western off-site areas will extend outward from the property lines and end where visual surficial evidence of manufacturing operations between the MMI facility and the eastern edge of the adjoining railroad spur.

The off-site excavated areas will be backfilled with clean soil and revegetated. The existing property lines will serve as center and highest elevation point of the graded slope. This will effectively drain precipitation to respective properties and eliminate any run-offs onto, or from, the MMI property.

Care will be taken on the eastern off-site area of the property when backfilling around existing telephone poles. Backfill will meet the existing curb of West Third Street in a downward grade. Backfill will be placed in areas on the western side of the property to facilitate drainage back to the Master Metals property.

On-site, all areas excavated or subgrade (e.g., sumps, pits, etc.) would be backfilled to grade. A geotextile will be placed between the contaminated material and clean fill to prevent mixing of the materials in the future. All excavated off-site material would be consolidated on-site. All contaminated areas would then be covered with two (2) feet of clean fill (a concrete barrier already exists) and revegetated. Two feet of cover will be placed over those areas where consolidated material is located on site.

In order to facilitate future reuse of the property, only the most severely deteriorated portions of the property will encompass the cover system. Figure 4-1 shows the approximate location of the cover system. Those areas not covered by soil will be reconditioned by sealing cracks followed by scarification or encapsulation of the concrete surface to provide useable site for future operations.

Operation and maintenance of the cover would need to be performed for thirty years. This would consist of mowing the vegetation once per year and inspecting the cover to ensure integrity of the cover has not been compromised.

Deed restrictions would be necessary to minimize potential exposure to the soil material beneath the cover. These restrictions would call for certain procedures (i.e. health and safety plans) to follow for any future possible construction or installation of underground utilities beneath the cover systems.

- Overall Protection of Public Health and the Environment

Alternative 2 would provide adequate protection to public health and the environment. All contaminated surficial soils will have been covered, thereby eliminating the potential of inhalation or ingestion from these contaminated soils. Additionally, site dangers such as open pits and sumps will have been eliminated and a new industrial grade fence installed. These institutional controls and maintenance of the cover will ensure that the remedy will remain effective for the foreseeable future.

- Compliance with ARARs and Other Criteria, Advisories, and Guidance

This alternative would be designed to address the threat to public health resulting from the contaminants in the off-site and on-site solid media. This alternative should comply with the appropriate regulatory requirements for remediation of the solid media of concern.

- Long-Term Effectiveness and Permanence

Alternative 2 would provide a significant reduction in the potential for exposure to contaminants over the long term. Long term maintenance of the cover would need to be performed to ensure the effectiveness of the cover system. These institutional controls and maintenance of the cover will ensure that the remedy will remain effective for the foreseeable future.

- Reduction of Toxicity, Mobility, or Volume Through Treatment

Phase I time-critical removal activities reduced the toxicity, mobility, and volume of contamination through treatment and off-site disposal of approximately 1,000 cubic yards of lead impacted soils. Alternative 2 would reduce the off-site contaminated solids toxicity and volume of material because all off-site contaminated solids would be consolidated. In addition, mobility would be reduced as the materials would no longer be directly exposed to the environment.

- Short-Term Effectiveness

Implementation of Alternative 2 would take approximately 3 - 4 weeks to complete. Short-term risks to on-site workers and the community would be minimal as minimal amounts of contaminated material would be disturbed during cover installation. Workers would be trained in hazardous waste site operations and would wear the appropriate protective clothing to mitigate these concerns.

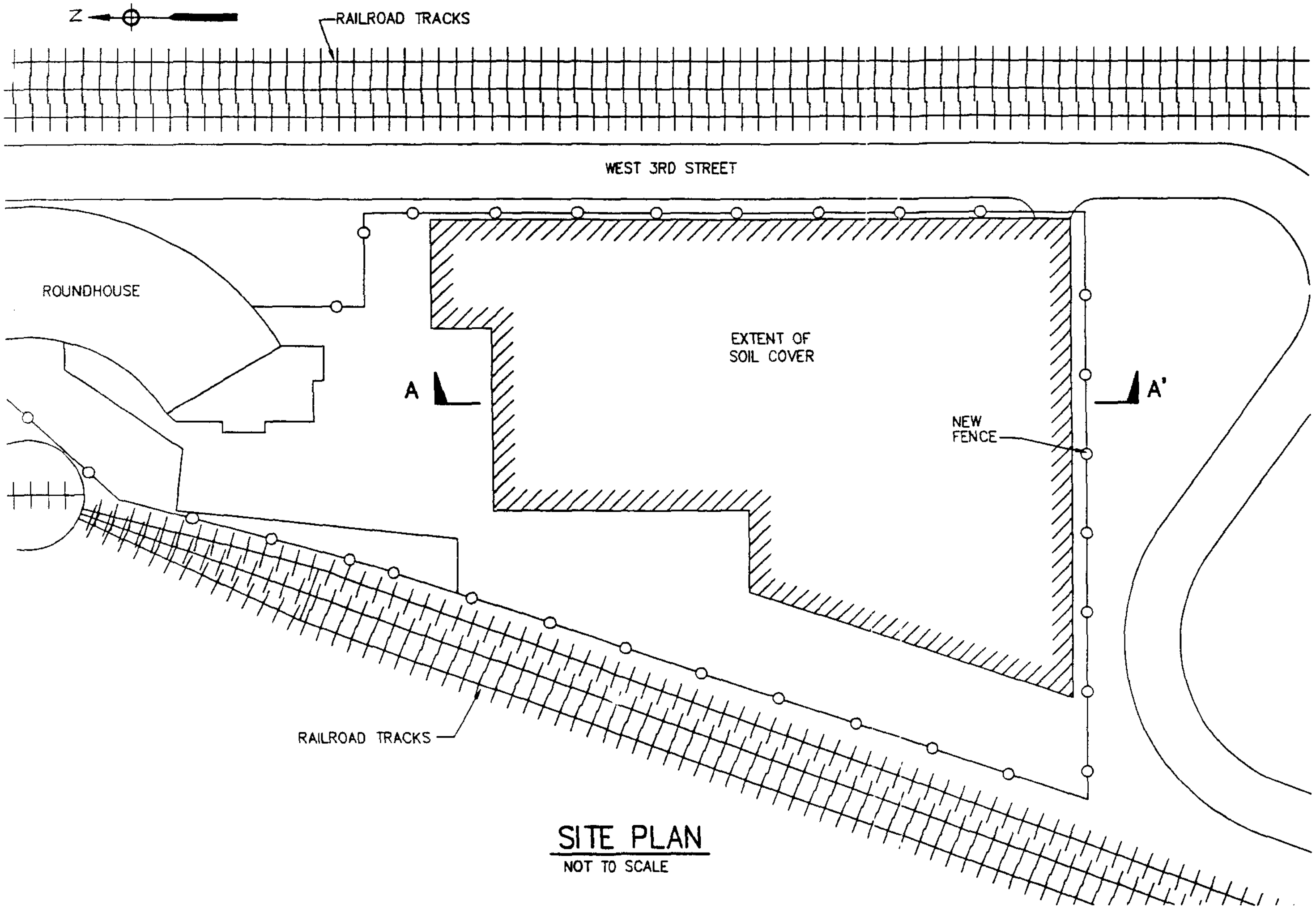
- Implementability

Alternative 2 would be easy to implement from a technical and administrative standpoint. Covering contaminated soil is a commonly utilized remedial action and was partially performed on-site during the Phase I Removal Actions.

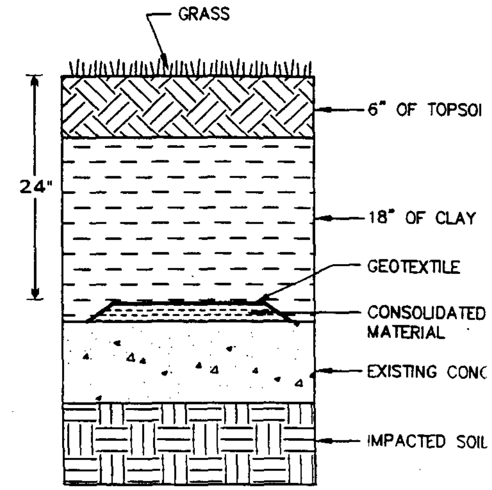
➤ Alternative 2 Costs

Item/Description	Total Cost
DIRECT CAPITAL COSTS	
Construction Costs	$ 41,700
Equipment & Material	$206,800
Building and Services Costs	$ 45,000
Transport and Disposal Costs	$ 1,000
Analytical Costs	$ 6,700
Treatment and Operating Costs	$108,000
Contingency Allowances (20%)	$ 60,240
SUBTOTAL DIRECT COSTS	$467,440
INDIRECT CAPITAL COSTS	
Engineering and Design Expenses	$ 35,000
Legal Fees and License or Permit Costs	$ 10,000
Mobilization and Demobilization Cost	$ 15,000
SUBTOTAL INDIRECT COSTS	$ 60,000
OPERATION AND MAINTENANCE (30 year)	$ 9,600
PRESENT WORTH ANALYSIS*	
Total Capital Costs (from above)	$537,040
TOTAL PRESENT WORTH	$537,040

*Present Worth Analysis assumes a 4 % inflation rate and 7 % interest rate over thirty years for Operation & Maintenance



SITE PLAN
NOT TO SCALE



A–A' CROSS SECTION
NOT TO SCALE

NOTES:

ALTERNATIVE 2 INCLUDES THE FOLLOWING ITEMS:

- OFF-SITE, IMPACTED SOIL WILL BE EXCAVATED, TREATED (IF NECESSARY), AND CONSOLIDATED ON-SITE.
- 2-FEET OF SOIL COVER WILL BE PLACED OVER ON-SITE IMPACTED AREAS. THE COVER WILL BE SLOPED TO MINIMIZE OFF-SITE RUNOFF.
- OPEN PITS AND SUMPS WILL BE BACKFILLED.
- A NEW CHAIN-LINKED FENCE WILL BE INSTALLED AROUND THE PERIMETER OF THE SITE.

FORMER MASTER METALS S CLEVELAND, OHIO CONCEPTUAL SITE PLAN FOR ALTERNATIVE 2	
SCALE: NOT TO SCALE	FIGURE
PROJ. NO.	

4.3.3 Alternative 3 - Off-site Excavation, On-site Consolidation, On-site Capping, O & M

Under Alternative 3, off-site contaminated soils would be excavated to 1,000 mg/kg or until the original historical slag fill which was deposited in this area in the 1900s is encountered and consolidated on-site. The material will be tested to determine if treatment is required prior to consolidation. All contaminated surficial soils will be capped, thereby eliminating the potential of inhalation or ingestion from these contaminated soils. Additionally, site dangers such as open pits and sumps will have been eliminated.

Off-site excavation of contamination will require the removal and subsequent replacement of the entire site fencing. Additionally, all off-site areas will require clearing and grubbing. Both measures are necessary to effectively excavate all contamination. All site fencing will be replaced with industrial grade fence topped with three strands of barb wire.

The off-site areas will extend outward from the eastern, western, and southern boundary lines of MMI. Existing structures will limit the areas of excavation around the site perimeter. For example, railroads exist on the east and west sides of the facility. Railroad ballast has historically been shown to contain lead and other heavy metals originating from jernal bearing leakage. Because the railroad tracks are currently in use and because the site contamination has been commingled with other anthropogenic sources of contamination, it is not practical to excavate around these structures. In addition, the area between the western portion of the facility property and Quigley Avenue is comprised of railroad tracks. Therefore, the off-site areas will extend outward as follows: the eastern and southern off-site area will extend outward from the property line and end at the existing concrete curb of West Third Street; the western off-site areas will extend outward from the property lines and end where visual surficial evidence of manufacturing operations between the MMI facility and the eastern edge of the adjoining railroad spur.

The off-site excavated areas will be backfilled with clean soil and revegetated. The existing property lines will serve as center and highest elevation point of the graded slope. This will effectively drain precipitation to respective properties and eliminate any run-offs onto or from the MMI property.

Care will be taken on the eastern off-site area of the property when backfilling around existing telephone poles. Backfill will meet the existing curb of West Third Street in a downward grade. Backfill will be placed in areas on the western side of the property to facilitate drainage back to the Master Metals property.

Under Alternative 3, on-site areas that have been excavated or are currently subgrade (e.g., sumps, pits, etc.) would be backfilled to grade. A geotextile will be placed between the contaminated material and clean fill to prevent mixing of the materials in the future. All excavated off-site material would be consolidated on-site. All contaminated areas would then be capped with a four (4) inch asphalt cap (a concrete barrier already exists). Maintenance of the cap system will be required to ensure continued protectiveness.

In order to facilitate future reuse of the property, only the most severely deteriorated portions of the property will encompass the cover system. Figure 4-2 shows the approximate location of the cap system. Those areas not covered by asphalt will be reconditioned by sealing cracks followed by scarification or encapsulation of the concrete surface to provide useable site for future operations.

Operation and maintenance of the cap would need to be performed for thirty years. This would consist of semiannual inspection of the cap and repairing any significant cracks in the cap. In addition, a sealer would be applied every five years.

Deed restrictions would be necessary to minimize potential exposure to the soil material beneath the asphalt cap. These restrictions would call for certain procedures (i.e. health and safety plans) to follow for any future possible construction or installation of underground utilities under the cap systems.

- Overall Protection of Public Health and the Environment

Alternative 3 would provide adequate protection to public health and the environment. All contaminated surficial soils will have been capped, thereby eliminating the potential of inhalation or ingestion from these contaminated soils. Additionally, site dangers such as open pits and sumps will have been eliminated and a new industrial grade fence installed. These institutional controls and maintenance of the cap will ensure that the remedy will remain effective for the foreseeable future.

- Compliance with ARARs and Other Criteria, Advisories, and Guidance

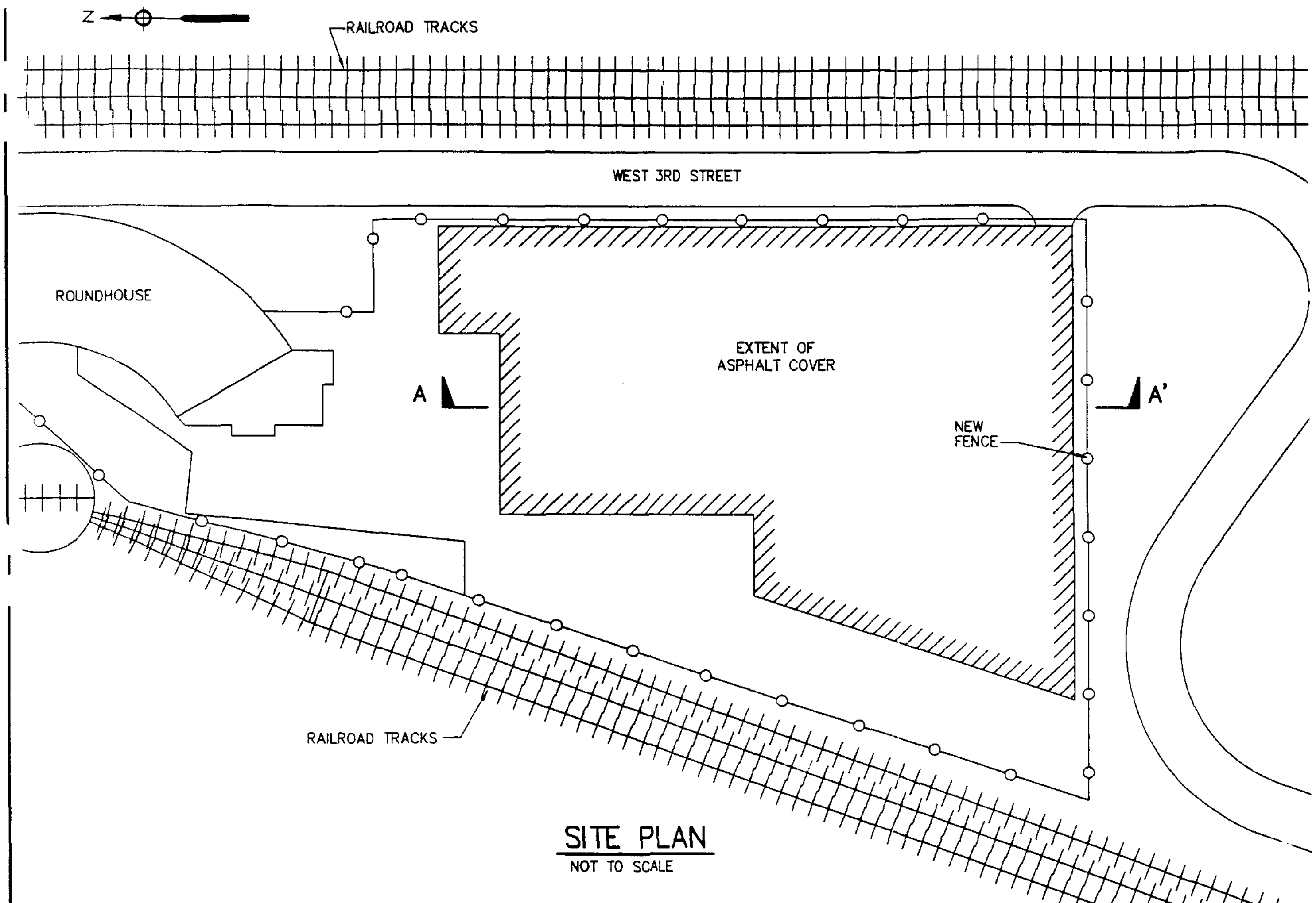
This alternative would be designed to address the threat to public health resulting from the contaminants in the off-site and on-site solid media. This alternative should comply with the appropriate regulatory requirements for remediation of the solid media of concern.

- Long-Term Effectiveness and Permanence

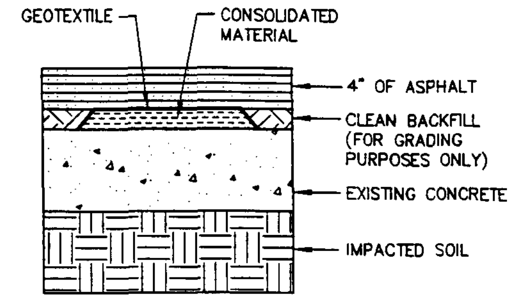
Alternative 3 would provide a significant reduction in the potential for exposure to contaminants over the long term. Long term maintenance of the cap would need to be performed to ensure the effectiveness of the cap system. These institutional controls and maintenance of the cap will ensure that the remedy will remain effective for the foreseeable future.

- Reduction of Toxicity, Mobility, or Volume Through Treatment

Phase I time-critical removal activities reduced the toxicity, mobility, and volume of contamination through treatment and off-site disposal of approximately 1,000 cubic yards of lead impacted soils. Alternative 3 would reduce the off-site contaminated solids toxicity and volume of material because all off-site contaminated solids would be consolidated. In addition, mobility would be reduced as the materials would no longer be directly exposed to the environment.



SITE PLAN
NOT TO SCALE



A--A' CROSS SECTION
NOT TO SCALE

NOTES:

ALTERNATIVE 3 INCLUDES THE FOLLOWING ITEMS:

- OFF-SITE, IMPACTED SOIL WILL BE EXCAVATED, TREATED (IF NECESSARY), AND CONSOLIDATED ON-SITE.
- A 4-INCH ASPHALT CAP WILL BE INSTALLED OVER THE EXISTING CONCRETE AREAS TO MINIMIZE DIRECT CONTACT WITH IMPACTED SOIL.
- OPEN PITS AND SUMPS WILL BE BACKFILLED.
- A NEW CHAIN-LINKED FENCE WILL BE INSTALLED AROUND THE PERIMETER OF THE SITE.

FORMER MASTER METALS SITE
CLEVELAND, OHIO

CONCEPTUAL SITE PLAN
FOR ALTERNATIVE 3

SCALE: NOT TO SCALE

PROJ. NO.

FIGURE 4-2

- Short-Term Effectiveness

Implementation of Alternative 3 would take approximately 4-5 weeks to complete. Short-term risks to on-site workers and the community would be minimal as minimal amounts of contaminated material would be disturbed during cap installation. Workers would be trained in hazardous waste site operations and would wear the appropriate protective clothing to mitigate these concerns.

- Implementability

Alternative 3 would be easy to implement from a technical and administrative standpoint. Capping contaminated soil is a commonly utilized remedial action and was partially performed on-site during the Phase I Removal Actions.

- Alternative 3 Costs

Item/Description	Total Cost
DIRECT CAPITAL COSTS	
Construction Costs	$ 77,400
Equipment & Material	$329,000
Building and Services Costs	$ 45,000
Transport and Disposal Costs	$ 1,000
Analytical Costs	$ 5,300
Treatment and Operating Costs	$108,000
Contingency Allowances (20%)	$ 91,540
SUBTOTAL DIRECT COSTS	$656,240
INDIRECT CAPITAL COSTS	
Engineering and Design Expenses	$ 35,000
Legal Fees and License or Permit Costs	$ 15,000
Mobilization and Demobilization Cost	$ 15,000
SUBTOTAL INDIRECT COSTS	$ 65,000
OPERATION AND MAINTENANCE (30 year)	$133,900
PRESENT WORTH ANALYSIS	
Total Capital Costs (from above)	$855,140
TOTAL PRESENT WORTH	$855,140

*Present Worth Analysis assumes a 4 % inflation rate and 7 % interest rate over thirty years for Operation & Maintenance

4.3.4 Alternative 4 -Off-site Excavation, Treatment, Off-site Disposal, On-site Capping, O & M

Under Alternative 4, off-site contaminated soils would be excavated to 1,000 mg/kg or until the original historical slag fill which was deposited in this area in the 1900s is encountered, and consolidated on-site. Excavation of contaminated soils will occur in the off-site areas of the eastern, western, and southern sides of the Master Metals property. Existing structures will limit the areas of excavation around the site perimeter. For example, railroads exist on the east and west sides of the facility. Railroad ballast has historically been shown to contain lead and other heavy metals originating from jernal bearing leakage. Because the railroad tracks are currently in use and because the site contamination has been commingled with other anthropogenic sources of contamination, it is not practical to excavate around these structures. In addition, the area between the western portion of the facility property and Quigley Avenue is comprised of railroad tracks. The off-site areas will extend outward from the eastern, western, and southern boundary lines of MMI as follows: the eastern and southern off-site area will extend outward from the property line and end at the existing concrete curb of West Third Street; the western off-site areas will extend outward from the property lines and end where visual surficial evidence of manufacturing operations between the MMI facility ends and the eastern edge of the adjoining railroad spur.

To ensure complete removal of all contamination in this alternative, removal and subsequent replacement of the entire site fencing is necessary. Off-site areas may also require clearing and grubbing prior to any excavation activities commencing. Caution should be used when excavating around off-site telephone poles. Additionally, utilities should be located prior to excavation. Upon completion of this alternative, all site fencing will be replaced with industrial grade fence topped with three strands of barb wire.

Off-site areas exceeding the risk-based standard will be excavated to a native historical slag fill horizon or until a cleanup criteria of 1,000 ppm total lead is reached. Excavation in the eastern off-site area will extend outward to the existing concrete curb of West Third Street. Excavation in the southern and western off-site areas will extend outward until visual surficial evidence of manufacturing operations from the MMI facility ceases. All material excavated from these off-site areas will undergo a treatability study to determine if treatment of this material is a viable option. After treatment (if required), material would be transported to an off-site disposal facility.

Clean fill material will be utilized to backfill all off-site excavated areas to grade. A geotextile will be placed between the contaminated material and clean fill to prevent mixing of the on-site materials in the future. Existing property lines will again serve as center and highest elevation point of the graded slope. This will drain precipitation to respective properties and eliminate any run-offs onto or off of the MMI property. These areas will be re-seeded to minimize erosion.

On-site capping will consist of asphalting directly on top of deteriorated areas of the existing concrete pad. Clean backfill may be required in some areas to level the pad for proper drainage. On-site capping will consist of 4 inches of asphalt due to the existing concrete barrier. All asphalt will be sealed with appropriate asphalt sealer upon curing.

In order to facilitate future reuse of the property, only the most severely deteriorated portions of the property will encompass the cap system. Figure 4-3 shows the approximate location of the cap system. Those areas not covered by asphalt will be reconditioned by sealing cracks followed by scarification or encapsulation of the concrete surface to provide useable site for future operations.

Operation and maintenance of the cap would need to be performed for thirty years. This would consist of semiannual inspection of the cap and repairing any significant cracks in the cap. In addition, a sealer would be applied every five years.

Deed restrictions would be necessary to minimize potential exposure to the soil beneath the cap. These restrictions would call for special procedures (i.e. health and safety plans)during any possible future construction, if applicable, such as installation of underground utilities under the cap systems.

- Overall Protection of Public Health and the Environment

Alternative 4 would be expected to provide off-site protection of human health and the environment by eliminating all potential for exposure to contaminants at the site by removing contaminants in those impacted areas and then backfilling with a clean fill. By removing contamination to this level, human health risks associated with potential ingestion or inhalation of off-site solids contamination would be eliminated.

All on-site contaminated surficial soils will have been capped, thereby eliminating the potential of inhalation or ingestion from these contaminated soils. Additionally, site dangers such as open pits and sumps will have been eliminated and a new industrial grade fence installed. These institutional controls and maintenance of the cap will ensure that the remedy will remain effective for the foreseeable future.

- Compliance with ARARs and Other Criteria, Advisories, and Guidance

This alternative would be designed to address the threat to public health resulting from the contaminants in the off-site and on-site solid media. This alternative should comply with the appropriate regulatory requirements for remediation of the solid media of concern.

- Long-Term Effectiveness and Permanence

Alternative 4 has significant long term effectiveness due to removal of the off-site contaminated soils. However, long term effectiveness of capping on-site soils will be assessed by how well the cap is installed and maintained. These institutional controls and maintenance of the cap will ensure that the remedy will remain effective for the foreseeable future.

- Reduction of Toxicity, Mobility, or Volume Through Treatment

Phase I time-critical removal activities reduced the toxicity, mobility, and volume of contamination through treatment and off-site disposal of approximately 1,000 cubic yards of lead impacted soils. Off-site soils will be removed resulting in a decrease of toxicity, mobility, and volume of off-site material. On-site soils will have a reduction in mobility as these materials will be capped in place. However, there will be no toxicity or volume reductions as this material is not being removed or treated.

- Short-Term Effectiveness

Implementation of alternative 4 would take approximately 5 - 6 weeks to complete. Excavation activities would occur on the eastern, southern, and western sides of the property. Treatment and storage of material can be positioned in the northern areas of the site that were utilized during Phase I activities. Capping and fence installation would occur last in the sequencing of events.

Short term risks to on-site workers and the community will be limited due to dust emissions, potential direct exposure to contaminants, and general construction hazards during these remedial activities.

- Implementability

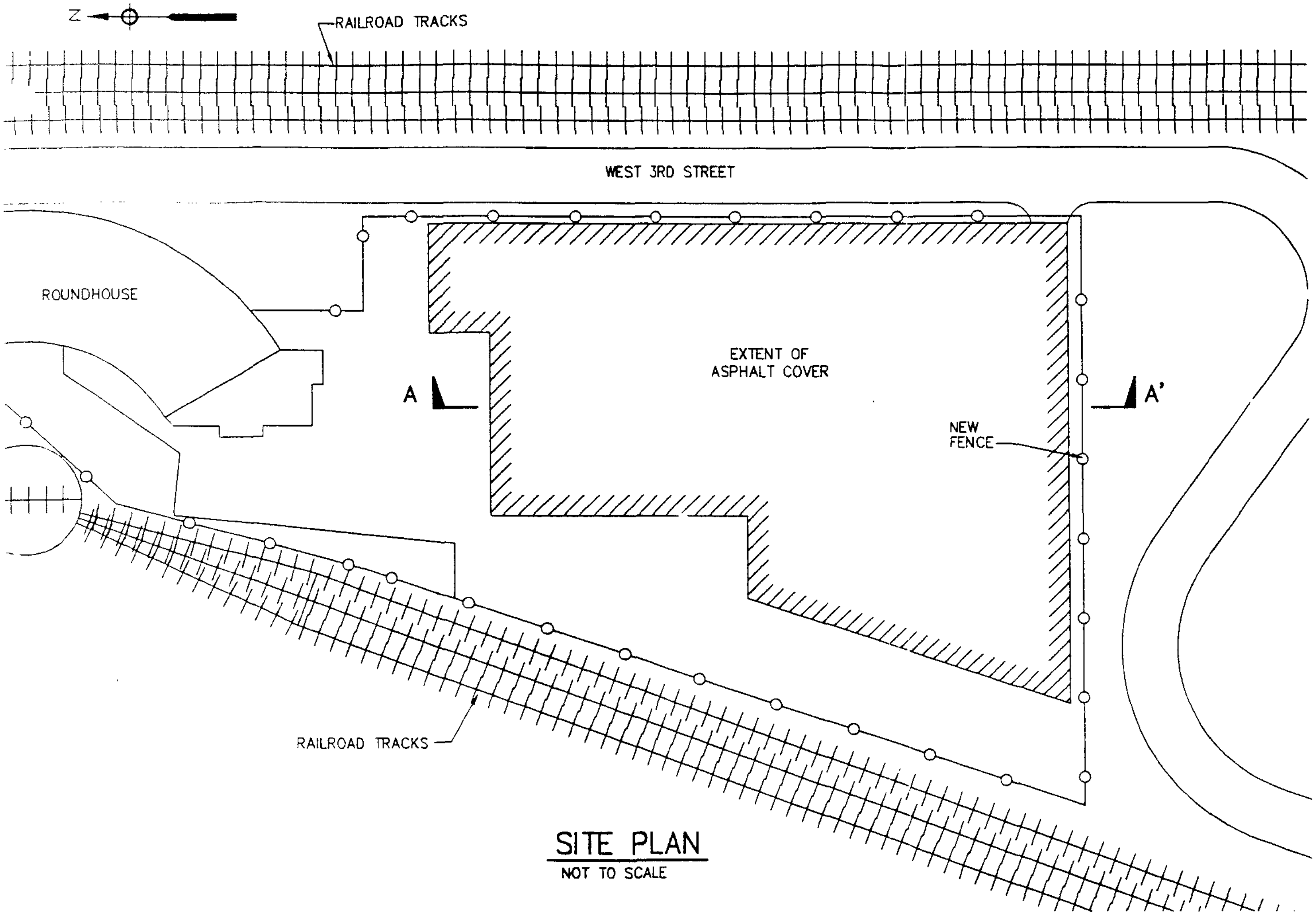
Alternative 4 would be easy to implement from a technical and administrative standpoint. Excavating and treating contaminated soil are common activities in remediation work.

Site grading will require a bit more technical work to ensure that the property has proper drainage.

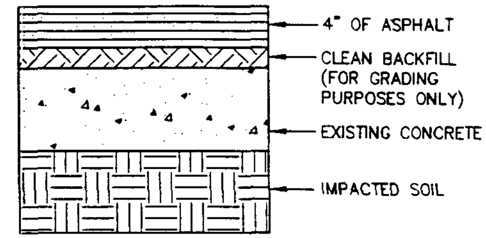
- Alternative 4 Costs

Item/Description	Total Cost
DIRECT CAPITAL COSTS	
Construction Costs	\$ 91,200
Equipment & Material	\$318,000
Building and Services Costs	\$ 45,000
Transport and Disposal Costs	\$ 71,300
Analytical Costs	\$ 11,300
Treatment and Operating Costs	\$108,000
Contingency Allowances (20%)	\$128,960
SUBTOTAL DIRECT COSTS	\$773,760
INDIRECT CAPITAL COSTS	
Engineering and Design Expenses	\$ 41,000
Legal Fees and License or Permit Costs	\$ 15,000
Mobilization and Demobilization Cost	\$ 23,000
SUBTOTAL INDIRECT COSTS	\$ 79,000
OPERATION AND MAINTENANCE (30 year)	\$133,900
PRESENT WORTH ANALYSIS*	
Total Capital Costs (from above)	\$986,660
TOTAL PRESENT WORTH	\$986,660

*Present Worth Analysis assumes a 4 % inflation rate and 7 % interest rate over thirty years for Operation & Maintenance



SITE PLAN
NOT TO SCALE



A–A' CROSS SECTION
NOT TO SCALE

NOTES:

ALTERNATIVE 4 INCLUDES THE FOLLOWING ITEMS:

- OFF-SITE IMPACTED SOIL WILL BE EXCAVATED, TREATED (IF NECESSARY), AND TRANSPORTED TO AN OFF-SITE PERMITTED DISPOSAL FACILITY AS A NON-HAZARDOUS WASTE. EXCAVATED AREAS WILL BE BACKFILLED WITH CLEAN FILL.
- A 4-INCH ASPHALT CAP WILL BE INSTALLED OVER THE EXISTING CONCRETE AREAS TO MINIMIZE DIRECT CONTACT WITH IMPACTED SOIL.
- OPEN PITS AND SUMPS WILL BE BACKFILLED.
- A NEW CHAIN-LINKED FENCE WILL BE INSTALLED AROUND THE PERIMETER OF THE SITE.

FORMER MASTER METALS SITE
CLEVELAND, OHIO

CONCEPTUAL SITE PLAN
FOR ALTERNATIVE 4

SCALE: NOT TO SCALE

PROJ. NO.

FIGURE 4-3

5.0 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

The relative performance of each source control measure are summarized in Table 5.1. Each of these alternatives is discussed in detail below.

5.1 Alternative 1: No Action

This alternative would not be protective of human health. All potential inhalation and ingestion pathways would still be present. In addition, this alternative would not comply with ARARs for contaminated solids. Since there is no containment, removal, or treatment of the contaminated media, the long term effectiveness of this alternative is low. There would be no reduction in toxicity, mobility, or volume. Being a no action alternative, this alternative would be technically easy to implement. There would be no cost associated with the completion of this alternative.

5.2 Alternative 2: Off-site Excavation, On-site Consolidation, On-site Cover, Operation & Maintenance

Under this alternative, pathways for human exposure would be significantly reduced. ARARs would be attained through covering of the contaminated soils. The cover would afford long term protection from exposure to solid media contaminants provided that it is maintained. Mobility of solid contaminants would be reduced through this action, although toxicity and volume would be essentially unaffected for on-site materials. Short term risks to community and on-site workers would be present due to the potential for dust emission and direct contact during cover installation. This alternative would be technically easy to implement. This alternative would place permanent deed restrictions on the future use of the property. The costs associated with this alternative are $537,040.

5.3 Alternative 3: Off-site Excavation, On-site Consolidation, On-site Capping, O&M

Under this alternative, pathways for human exposure would be significantly reduced. ARARs would be attained through capping of the contaminated soils. The cap would afford long term protection from exposure to solid media contaminants provided that it is maintained. Mobility of solid contaminants would be reduced through this action, although toxicity and volume would be essentially unaffected. Short term risks to community and on-site workers would be present due to the potential for dust emission and direct contact during cover installation. This alternative would be technically easy to implement. This alternative would place permanent deed restrictions on the future use of the property. The costs associated with this alternative are $855,140.

5.4 Alternative 4: Off-site Excavation, Treatment, Off-site Disposal, On-site Capping, O&M

This alternative would provide a high level of protection of human health from contaminants which exist around the perimeter of the site. Exposure pathways to off site contaminated solids would be eliminated through excavation. ARARs would be attained through capping of the on-site contaminated soils. The cap would afford long term protection from exposure to solid media contaminants provided that it is maintained. Mobility of solid contaminants would be reduced through this action, although toxicity and volume would be essentially unaffected for on-site materials. This alternative would be technically easy to implement. This alternative would place permanent deed restrictions on the future use of the property. The costs associated with this alternative are $986,600.

5.5 Selected Remedy

The selected remedy for this remedial action is Alternative 2: Off-site Excavation, On-Site Consolidation, and On-site Cover. This alternative eliminates all off-site exposures to human health and the environment. In addition, this alternative significantly reduces the on-site direct contact, inhalation and ingestion pathways with the two feet of cover. In conjunction with deed restrictions, this cover system will be maintained.

This cover system also will provide the optimal solution for future industrial reuse. Should the site be redeveloped, the cover system may undergo regrading with no disruption or intrusion into the contaminated subsurface. In addition, grading for the purposes of an asphalt surface as part of a redevelopment project would be simple.

As illustrated in Table 5.1, Alternatives 2, 3, and 4 all provide adequate protection to human health, meet ARARs, and are proven technologies that are easily implementable. However, because Alternative 2 can be performed quicker and at a lower cost, and Alternative 2 offers the most flexibility for future site reuse, it is the preferred remedy.

TABLE 5.1
MASTER METALS SUPERFUND SITE
COMPARISON OF REMEDIAL ALTERNATIVES

Alternative	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume	Short-term Effectiveness	Implementability	Cost
1: No Action	Low Not protective of human health. Exposure pathways would remain under this scenario.	Low Would not comply with ARARs.	Low No long-term solution to solid media contamination.	Low No reductions, since there would be no treatment options.	Medium No short-term risks to the community or environment. Site risks still persist.	Not applicable, because there are no actions to implement.	$0
2: On-site Consolidation with On-site Cover	High Pathways for human exposure would be eliminated for off-site solids and significantly reduced for on-site solids.	High ARARs would be attained through covering of contaminated solids.	Medium/High Cover would afford long-term reductions in exposure potential but would need to be maintained.	Medium Mobility of solid media contaminants would be reduced through covering. On-site toxicity and volume would be unaffected.	Medium Short-term risks would be limited to dust emissions and direct exposure potential during cover installation.	High Technically easy to implement.	$ 537,040
3:On-site Consolidation with On-site Capping	High Pathways for human exposure would be eliminated for off-site solids and significantly reduced for on-site solids.	High ARARs would be attained through capping of contaminated solids.	High Cap would afford long-term reductions in exposure potential but would need to be maintained.	Medium Mobility of solid media contaminants would be reduced through covering. On-site toxicity and volume would be unaffected.	Medium Short-term risks would be limited to dust emissions and direct exposure potential during cover installation.	High Technically easy to implement.	$ 855,140
4: On-site Consolidation, Treatment, On-site Capping	High Pathways for human exposure would be eliminated for off-site solids and significantly reduced for on-site solids.	High ARARs would be attained through capping of contaminated solids.	High Cover would afford long-term reductions in exposure potential but would need to be maintained.	Medium Mobility of solid media contaminants would be reduced through covering. On-site toxicity and volume would be unaffected.	Medium Short-term risks would be limited to dust emissions and direct exposure potential during cover installation.	High Technically easy to implement.	$ 986,660

Appendix A

Generic Numerical Standards and

Risk Assessment Procedures

Appendix A

Risk Based Remediation Goal (RBRG)
Full-time on-site worker
Input Parameters

Parameter	Default or Site Specific Value	Unit	Value	Comment
PbB_{fetal}	Default	µg/dL	10	For estimating RBRGs based on risk to the developing fetus.
GSD_i	**Site Specific**	--	1.8	Value of 1.8 is based on demographics similar to U.S. demographics.
$R_{fetal/maternal}$	Default	--	0.9	Based on Goyer (1990) and Graziano et al. (1990).
$PbB_{adult,0}$	**Site Specific**	µg/dL	2.0	Plausible range based on NHANES III phase 1 for women of child bearing age (Brody et al. 1994; Brody, 1995).
BKSF	Default	µg/dL per µg/day	0.4	Based on analysis of Pocock et al. (1983) and Sherlock et al. (1984) data.
IR	Default	g/day	0.05	Predominantly indoor occupational exposures.
EF	Default	day/yr	250	Full-time on-site worker.
AF	Default	--	0.12	Based on an absorption factor for soluble lead of 0.20 and a relative bioavailability of 0.6 (soil/soluble).

NOTE: $PbB_{adult,\ central}$ is calculated to be 4.225 µg/dL.

Risk Based Remediation Goal (RBRG)
Comparison of Full-Time Worker and Construction Worker
Input Parameters

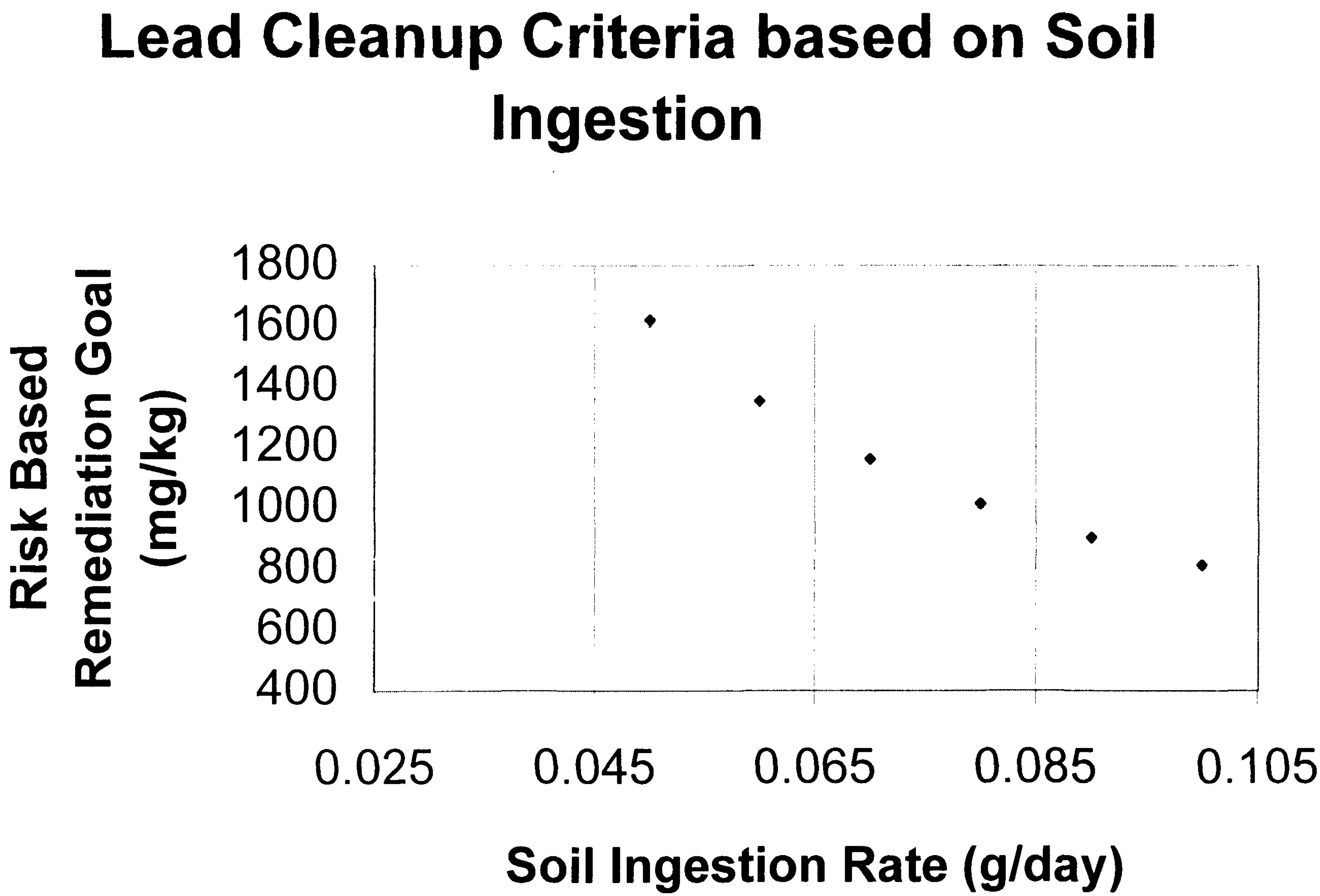
Parameter	Unit	Default Value	Onsite Worker Scenario	Construction Worker Scenario
$PbB_{fetal, 0.95, goal}$	µg/dL	10	10	10
$GSD_{i, adult}$	--	1.8, 2.1	1.8	1.8
$R_{fetal/maternal}$	--	0.9	0.9	0.9
$PbB_{adult, 0}$	µg/dL	1.7-2.2	2.0	2.0
BKSF	µg/dL per µg/day	0.4	0.4	0.4
IR_S	g/day	0.05	0.05	0.07 - 0.09
EF_S	day/yr	250	250	172
AT	days/yr	365	365	301
AF_S	--	0.12	0.12	0.12

NOTE: $PbB_{adult, central}$ is calculated to be 4.225 µg/dL.

RISK BASED REMEDIATION GOAL (RBRG) EQUATIONS

$$PbB_{adult,\ central,\ goal} = \frac{PbB_{fetal,\ 0.95,\ goal}}{GSD^{1.645}_{i,adult}\ R_{fetal/maternal}} \qquad RBRG = PbS = \frac{(PbB_{adult,\ central,\ goal} - PbB_{adult,\ 0})\ AT}{(BKSF\ \ IR_S\ \ AF_S\ \ EF_S)}$$

$PbB_{adult,\ central}$	=	Central estimate of blood lead concentrations (μg/dL) in adults (i.e., women of child-bearing age) that have site exposures to soil lead at concentration, PbS.
$PbB_{adult,\ 0}$	=	Typical blood lead concentration (μg/dL) in adults (i.e., women of child-bearing age) in the absence of exposures to the site that is being assessed.
PbS	=	Soil lead concentration (μg/g) (appropriate average concentration for individual).
BKSF	=	Biokinetic slope factor relating (quasi-steady state) increase in typical adult blood lead concentration to average daily lead uptake (μg/dL blood lead increase per μg/day lead uptake).
IR_S	=	Intake rate of soil, including both outdoor soil and indoor soil-derived dust (g/day).
AF_S	=	Absolute gastrointestinal absorption fraction for ingested lead in soil and lead in dust derived from soil (dimensionless).
EF_S	=	Exposure frequency for contact with assessed soils and/or dust derived in part from these soils (days of exposure during the averaging period); may be taken as days per year for continuing, long term exposure.
AT	=	Averaging time; the total period during which soil contact may occur; 365 day/year for continuing long term exposures.
$PbB_{adult,\ central,\ goal}$	=	Goal for central estimate of blood lead concentration (μg/dL in adults (i.e., women of child-bearing age) that have site exposures. The goal is intended to ensure that $PbB_{fetal,\ 0.95,\ goal}$ does not exceed 10 μg/dL.
$PbB_{fetal,\ 0.95,\ goal}$	=	Goal for the 95th percentile blood lead concentration (μg/dL) among fetuses born to women having exposures to the specified site soil concentration. This is interpreted to mean that there is a 95% likelihood that a fetus, in a woman who experiences such exposures, would have a blood lead concentration no greater than $PbB_{fetal,\ 0.95,\ goal}$ (i.e., the likelihood of a blood lead concentration greater than 10 μg/dL would be less than 5%, for the approach described int his report).
$GSD_{i,\ adult}$	=	Estimated value of the individual geometric standard deviation (dimensionless); the GSD among adults (i.e., women of child-bearing age) that have exposures to similar on-site lead concentrations, but that have non-uniform response (intake, biokinetics) to site lead and non-uniform off-site lead exposures. The exponent, 1.645, is the value of the standard normal deviate used to calculate the 95th percentile from a lognormal distribution of blood lead concentration.
$R_{fetal,maternal}$	=	Constant of proportionality between fetal blood lead concentration at birth and maternal blood lead concentration (dimensionless).


Lead Cleanup Criteria based on Soil Ingestion
Risk Based Remediation Goal (mg/kg)
1800
1600
1400
1200
1000
800
600
400
0.025
0.045
0.065
0.085
0.105
Soil Ingestion Rate (g/day)

Appendix B

Historical Lead Values at Industrial Sites

Historical Lead Values at Industrial Sites

Lead is a common constituent in soil although it occurs at low levels. The USGS estimates the national concentration of soil lead to be 16 ppm [11]. Elevated levels of soil lead can come from a wide variety of sources. The following paragraphs present the findings of a literature search to understand the contributions of lead-based paint and automobile emissions to elevated lead levels which may be found in soil and dust.

Sources of soil lead and dust lead

A report entitled "HUD National Survey: Findings on the Lead Paint Hazard in Homes" presents data on the prevalence, condition, and amount of lead-based paint in housing. In addition, the report presents information on the sources and pathways of lead in homes. Statistical relationships were studied to relate soil lead to potential sources. The strongest predictors of soil lead were dwelling age and county of residence. Dwelling age relates to the amount of time that lead has been depositing in the soil. County of residence factors include population growth, population density, traffic, and building/pointing practices.

Statistical relationships for dust lead were less conclusive although some factors were identified. For example, floor dust lead inside the main entrance is statistically associated with exterior soil lead and exterior paint that is leaded and damaged. In addition, floor dust lead in a wet room (defined as having plumbing) is significantly associated with wet room paint lead. Figure 1 shows the dust and soil lead pathways which are considered to be statistically significant from this study.

Lead-based paint as a source of lead

The literature specifies that there are four types of evidence used to support lead-based paint as a source of soil lead. These are:

1) Areal pattern,
2) Paint lead loading,
3) Age of the residence, and
4) Type and condition of the structure.

A Minnesota study [1] surveyed 213 wood exterior residences (mean soil PbS - 522 ppm) and 88 brick residences (mean soil PbS - 158 ppm) in five communities. The results showed that the PbS soil concentration was the highest for foundation samples in all cases. Almost all samples exceeding 2000 ppm and 140 out of 160 samples above 1000 ppm were collected from the foundation areas. A paint lead loading study [2] provided the following correlation to PbS soil concentration: 0-0.99 mg/cm^2, 200 ppm; 1.00-2.99 mg/cm^2, 300 ppm; 3.00-11.99 mg/cm^2, 650 ppm; and >12 mg/cm^2, 1100 ppm. A Michigan study [3] found the following relationship between residence age and median PbS soil concentration at the foundations: <20 years, 200 ppm; 20-100 years, 960 ppm; > 100 years, 1040 ppm. In Maine, a study [4] reported the soil concentration of PbS from the foundation of painted from buildings older than 30 years to be 1275 ppm (range: 50-100, 900 ppm) compared to 205 ppm (range: 50-700 ppm) in other areas. The same Michigan study referenced previously found that condition of the residence related to the PbS values as follows: residences in good to excellent condition, 200 ppm; fair condition, 940 ppm; poor condition, 1140 ppm.

Leaded gasoline emissions as a source of lead

There are several studies in the literature of he historical impact of leaded gasoline on soils. U.S. EPA's "Air Quality Criteria for Lead, Volumes I-IV" specifies that 40% of the lead which was emitted from a vehicular exhaust was greater than 10 microns and could be expected to be deposited by the roadway. The literature shows [5] that lead levels are highest by the roadway and decrease at depth and distance from the roadway. A rural community [3] measure PbS in roadside soils of 280 ppm, with a range of 100 to 840 ppm as compared to 200 ppm in background soils, with a range of 100 to 220 ppm.

Another study compared the amount of PbS in the soil as a function of traffic [6]. In Charleston, South Carolina, it was shown that as the number of vehicles emitting lead exhaust increases, the concentration in the surrounding soil increases. This study showed that a median traffic volume of 3200 vehicles/day resulted in a PbS concentration (at residences 250 feet away) greater than or equal to 585 ppm. Another study in Illinois [7] showed elevated PbS level with increasing traffic: less than 5000 cars/day showing 90 ppm PbS up to greater than 50,000 cars/day exhibiting soil lead levels of 236 ppm.

Whereas 40% of the lead emissions are large particles, 35% is in the form of fine particles (<0.25 microns) based on the same U.S. EPA report. This report noted that these particles disperse over larger distances from the roadway. There is a theory [8] that larger surface areas collect more of these finer particles as they "stick" to surfaces. A study from Minneapolis-St. Paul [9] showed that soil concentrations collected next to roadways closely resembled to concentrations of soil lead found at the foundations of adjacent residences. An electron scanning microscope investigation [10] found that a brick building with lead-based window trim paint 50 feet from a 2000 car/day roadway had soil lead levels (at the building line) of which 80-90% was from lead-based paint and the remaining 10-20% was of automobile origin.

From these examples it is clear that 1) the studies presented have variable levels of soil lead loadings. However, the trends are consistent and 2) lead emissions from vehicle exhausts have a contributing role to the concentration of lead in soil.

Conclusion

The literature clearly indicates that there is a correlation between soil lead concentrations and age and condition of buildings, paint lead loadings, and proximity to roadways. While most of the elevated levels are in the 1000-2000 ppm range, values as high as 10,000 ppm have been reported in the literature. Therefore, the lead value found proximate to the highway at the Master Metals site may be consistent with an elevated lead contamination scenario from either lead-based paint deterioration of the bypass roadway or automobile emissions from the elevated roadway.

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FIGURE 1

Dust and Soil Lead Pathways